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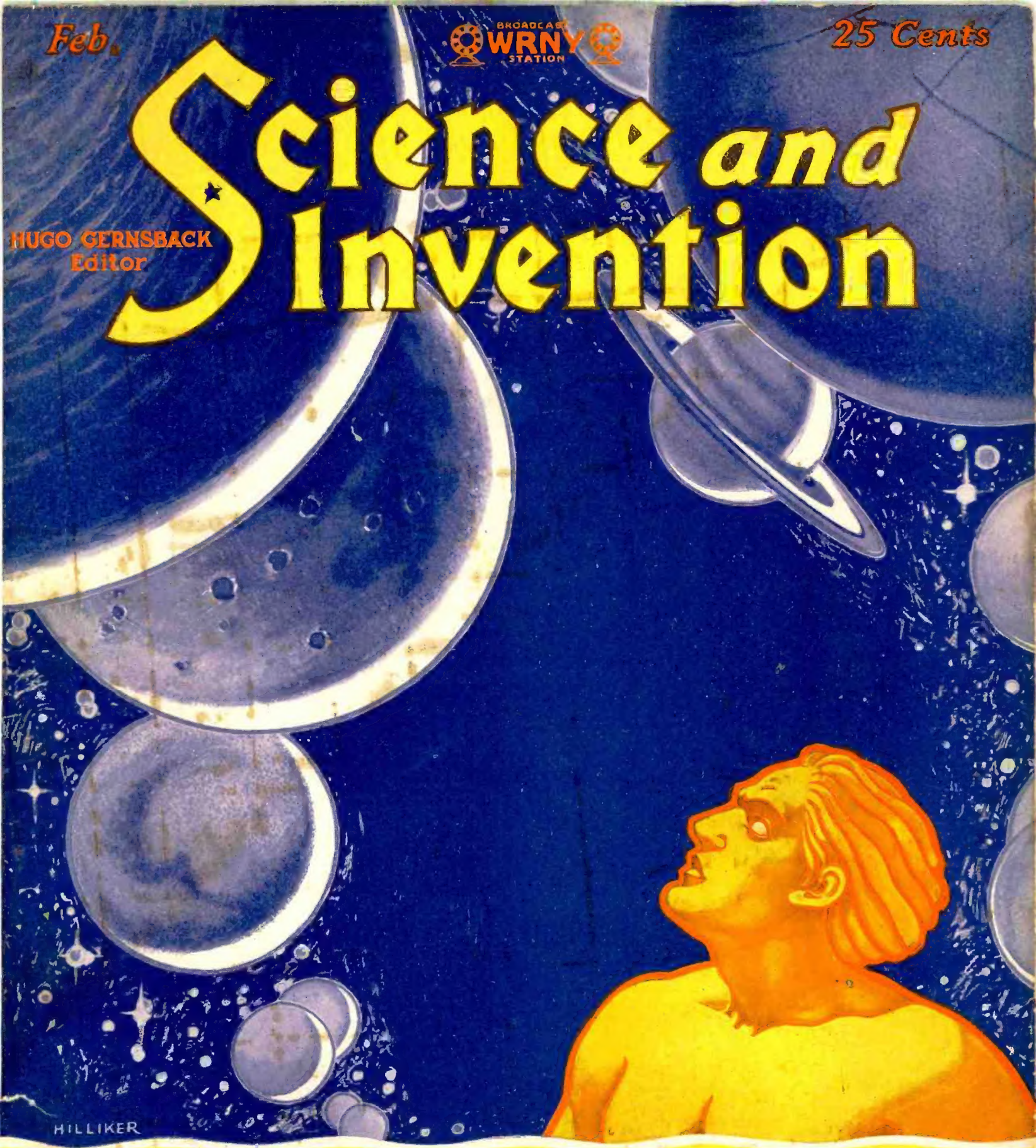


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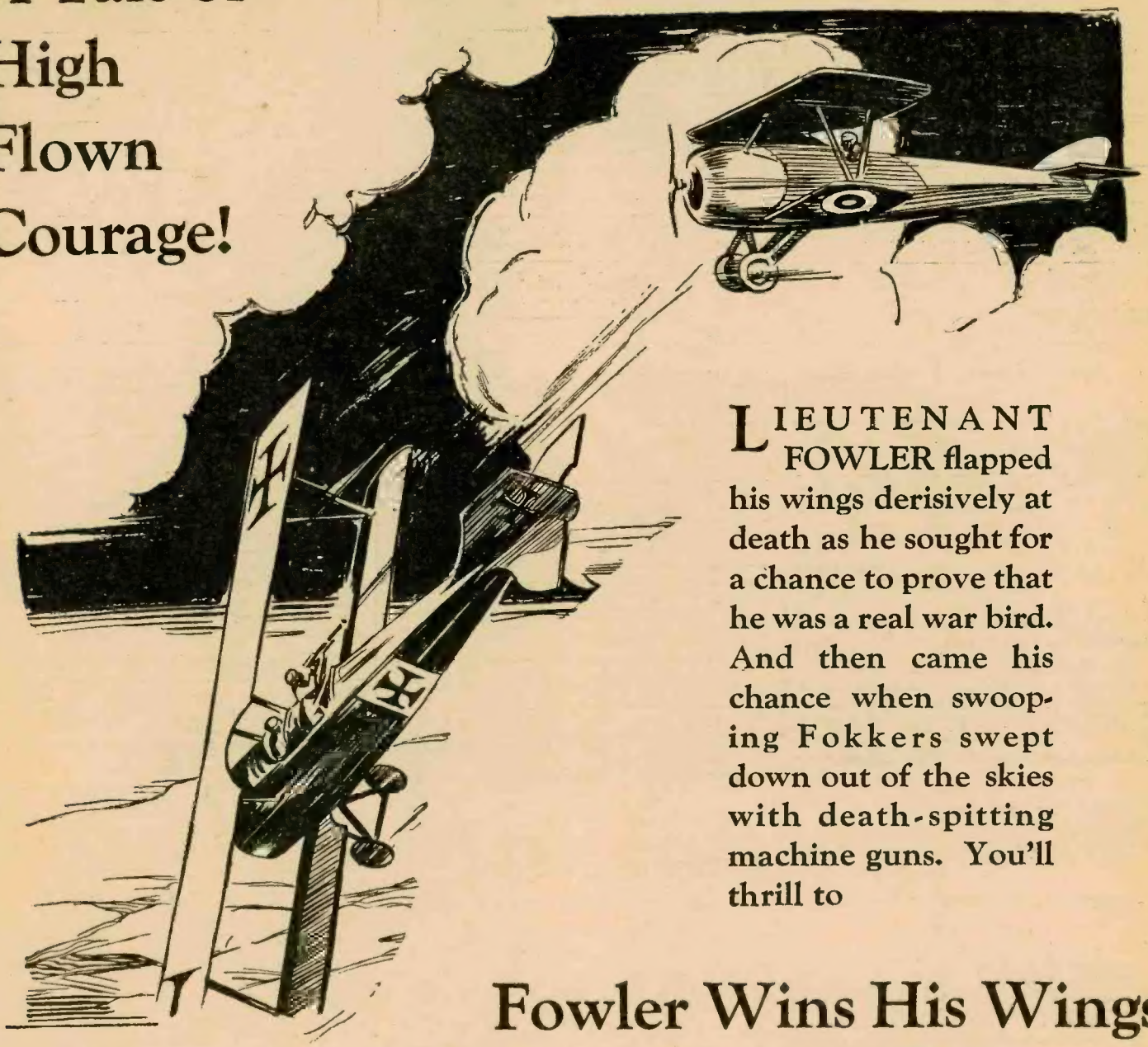

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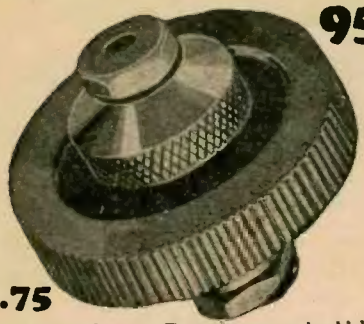

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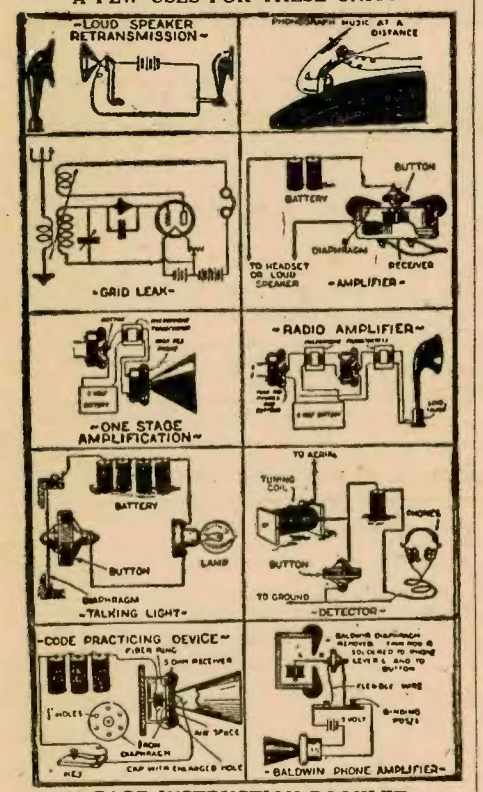


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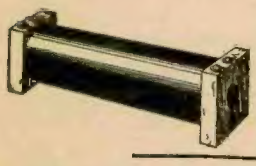

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# Building a Reflecting Telescope

(*Continued from page* 1003)

attention to see that the glass fits the tool, frequent rotating of the tool and glass and frequent testing are necessary to turn the one figure into the other. Unless very great care is used as the correct shadow is approached a shadow having stronger lights and shadows will be obtained. In other words the center will have been polished too deeply. There are ways of correcting this by making a tool with parts near the center removed but generally this leads to complications. Care at this time will save hours of work. Each time the mirror is set up for testing it should be allowed to rest for a few minutes before testing. Near the end of the work this period should be considerably longer each time.

The uniform surface indicated by figure 1 does not give a measure of the accuracy but only approximately what the surface is and that it is smooth. In short, to measure the parabola place the two cardboards as in figures 3 and 4, immediately in front of the glass one after the other. When the first is before the glass and the blade cuts off the light the hole should darken all at once and not from one side to the other. When the second is before the mirror it will be necessary to place the blade approximately 8/100 of an inch nearer to you to get the two sides to darken at the same time. If this condition exists and you have a shadow like figure 1 after the glass has stood for some time your glass has been completed and is ready to silver.

### *Silvering the Mirror*

THE curved surface of the glass must be silvered very carefully. The glass is rubbed with nitric acid on cotton, then with stannous chloride solution. This is then washed off and the silvering solutions added. Full description of silvering methods may be had by writing to Department of Commerce, Bureau of Standards, Washington, D. C. for Letter Circular LC-32. One method was also described on page 815 of SCIENCE AND INVENTION for January 1927.

The mounting of such a mirror may be made quite simple or it may be made with carefully machined castings and accurate adjustments. The important thing is to have the mirror in the tube facing very accurately the object which you are viewing. If it is turned sidewise a bit, a clear view is impossible. The other optical parts necessary are a 1 inch right angled prism and a Huyghenian eyepiece, or a lens of about 1 inch focal length. Figure 7 shows the relation of these parts.

There are several types of mountings which may be used. The one shown in the photograph is the yoke type equatorial mounting, the yoke of which points toward the north pole when adjusted. This type when carefully installed is one of the steadiest known.

*Materials for Making Mirror*

2—6 in. glass discs 1 in. thick
½ lb. No. 90 Carborundum granules
½ lb. No. 120 Carborundum granules
½ lb. No. 280 Carborundum granules
½ lb. No. 400 Carborundum granules
½ lb. No. 600 Carborundum granules
½ lb. No. 6F Turkish emery
1 lb. Optician's rouge
5 lbs. Pitch
Clear diluted lacquer
1 Safety razor blade
1 rule
1 small coal oil lamp

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FIG. 32

FIG. 49

Illustration of how the play is made.

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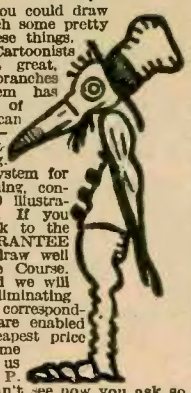

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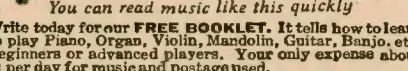

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## Refracting Telescope Can Be Built at Small Cost

(*Continued from page* 1001)

opera glasses, or, still better, binoculars may be used. A lens from a camera, particularly if it be of the portrait variety, is excellent.

The ideal lens is one that will bring all colors of light to the same focus. No objective ever made even approaches that ideal, but the ordinary simple lens is particularly bad. It is well known that white-light, in passing through a prism, is broken up into the rainbow colors, the blue rays being bent more than the red (Figure 5). We may regard a lens as being made up of a series of prisms. The diagram makes it quite clear how a blue image is formed nearer the lens than the red image. If a star is observed with the eye placed at A, one will see a circle, red in the center, blue at the edge. If the eye is moved to B, the colors will change places. The smaller the circle and the shorter the distance the eye must be moved to make the colors reverse, the better the lens. An image of the sun, reflected from a glass marble or a small Christmas tree ornament, makes an excellent artificial star for testing your lens. It is quite obvious (Figure 5) that a long-focus objective will cause less dispersion of the colors than one of short focus. I have always obtained the best results from simple lenses of focal length 30-40 inches, though much shorter focus may be used in emergency.

(*To be concluded*)

## Building a Reflecting Telescope

*By* Ernest W. Blandin

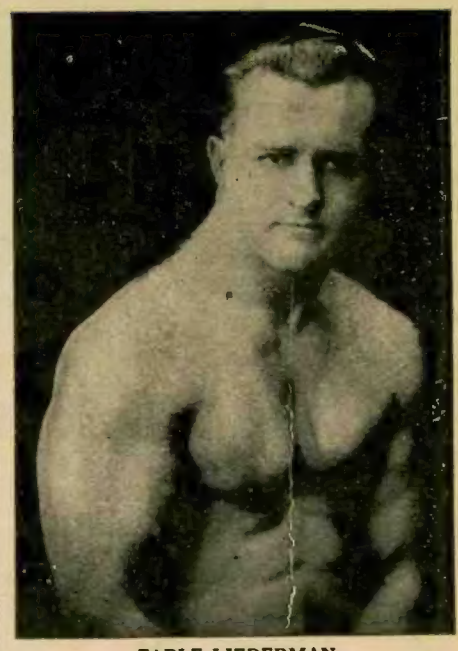
(*Continued from page* 942)

the organized work of all points on the surface that adds together and produces one image. This surface is commonly called the paraboloid.

The equipment for testing the surface consists of a safety razor blade, a block of wood, a small coal oil lamp with chimney replaced by an opaque tube in which a pin hole has been punched opposite the flame, a rule, and a support for the glass. The razor blade is placed in the block of wood so that its edge is vertical and exposed at the level of the pin hole in the lamp. To test the mirror it is placed on a support as in determining the focal length except for being at the level of a table, and the eye should be at the same level. The razor blade and lamp are placed side by side with the lamp to the right. The light from the pin hole should radiate toward the glass and the reflected light should come to a focus on the razor blade. This will take careful adjusting. Now place the eye just behind the blade and move the blade sidewise until the light just grazes the edge. You now see the mirror and certain shadows on it, if the blade is near the focus of the rays of light. The focal length with the light will be about twice what it will be on a star. The paraboloidal shadow is represented in diagram 1 and when perfect the shades of light should change across its surface as the shades of color of a delicate rose. If short strokes have been used in polishing the shadow will probably appear as in diagram 2. This test is known as the Foucault knife-edge test.

Our problem now is to change the shadow on our mirror from the appearance of figure 2 to that of figure 1 and in order to do this it is usually necessary to reduce the polishing surface near the edge of the tar polisher by cutting the grooves horn-shaped. Careful

(*Continued on page* 1005)

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I like to get the weak ones. I delight in getting hold of a man who has been turned down as hopeless by others. It's easy enough to finish a task that's more than half done. But give me the weak, sickly chap and watch him grow stronger. That's what I like. It's fun to me because I know I can do it and I like to give the other fellow the laugh. I don't just give you a veneer of muscle that looks good to others. I work on you both inside and out. I not only put big, massive arms and legs on you, but I build up those inner muscles that surround your vital organs. The kind that give you real pep and energy—the kind that fire you with ambition and the courage to tackle anything set before you.

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Who says it takes years to get in shape. Show me the man who makes any such claims and I'll make him eat his words. I'll put one full inch on your arm in just 30 days. Yes, and two full inches on your chest in the same length of time. Meanwhile, I'm putting life and pep into your old back-bone. And from then on, just watch 'em grow. At the end of thirty days you won't know yourself. Your whole body will take on an entirely different appearance. But you've only started. Now comes the real works. I've only built my foundation. I want just 60 days more (90 in all) and you'll make those friends of yours who think they're strong look like something the cat dragged in.

### A REAL MAN

When I'm through with you you're a real man. The kind that can prove it. You will be able to do things you had thought impossible. And the beauty of it is you keep on going. Your deep full chest breathes in rich, pure air, stimulating your blood and making you just bubble over with vim and vitality. Your huge square shoulders and your massive muscular arms have that craving for the exercise of a regular he man. You have the flash to your eye and the pep to your step that will make you admired and sought after in both the business and social world.

This is no idle prattle, fellows. If you doubt me, make me prove it. Go ahead, I like it. I have already done this for thousands of others and my records are unchallenged. What I have done for them, I will do for you. Come then, for time flies and every day counts. Let this very day be the beginning of new life to you.

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# Refracting Telescope Can Be Built at Small Cost

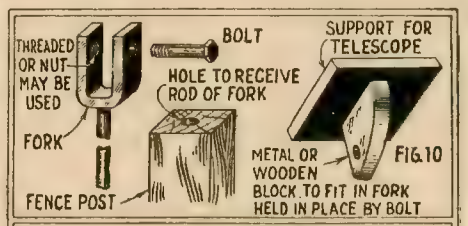
*By* Dr. Donald H. Menzel, Ph.D.

(*Continued from page* 943)

usually far beyond the pocketbook of the average person who desires to construct a telescope. Some amateurs have been able to polish their own mirror, which is somewhat easier to manufacture than a lens, but the process is too detailed to be made a part of the article. Since suitable lenses are far more plentiful than mirrors, I shall confine attention principally to the refracting telescope. Certainly anyone so fortunate as to be possessed of a concave mirror will be sufficiently ingenious to fill in any gaps in the following presentation and build himself an instrument that will work.

## *How to Select a Telescopic Objective*

The pupil of the eye can intercept just so much starlight. There is an old story to the effect that a certain astronomer once put belladonna in his eyes to enlarge the pupils so that he might see fainter stars. While the tale is probably untrue, it at least illustrates the prime function of the objective—to collect light. A one-inch telescope, i.e., one whose objective is an inch in diameter (about four times the diameter of the pupil of the eye) will collect sixteen times (four squared) as much light as the eye and hence will show stars sixteen times as faint as the eye can see.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SUPPORT FOR TELESCOPE
HOLE TO RECEIVE ROD OF FORK
FORK
METAL OR WOODEN BLOCK TO FIT IN FORK HELD IN PLACE BY BOLT
FIG 10
FENCE POST

*The above illustration shows how a mounting for the telescope can be constructed and appearance of completed telescope in use.*

The secondary purpose of the objective is magnification. As we have already seen, this depends solely upon its focal-length. The focus can be determined with sufficient accuracy by the following simple method. Clamp the lens and move the ground glass back and forth until the image of a distant object can be clearly seen upon it (e.g., an arc-light a block or two away). Then measure the distance between the objective and the ground glass. This will be F, the focal length, a figure that should be carefully preserved for future reference.

Almost any old convex lens can be pressed into service. The glass from a hand-magnifier, a spectacle lens, the objective from an old telescope, surveyor's transit, field glasses,

(*Continued on page* 1003)

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to stay upon the water for several days if necessary. By that time, the radio will have summoned help and the passengers can easily be taken off and the empty pontoons either towed to the next port or if that is not desirable, they can be sunk by admitting water into them when they will immediately sink and present no danger to shipping thereafter.

In most cases, however, except where the distances would be too great, they might be towed to the nearest port and salvaged.

We have considered the case of a ship going down with the pontoons floating off as the ship goes down. In one instance, this could not be done, and that is if fire broke loose. In this case, it would perhaps not be possible to wait until the ship sank, because long before this all the passengers and the pontoons would be destroyed by the ensuing heat if the vessel did not sink at once, as often happens.

A provision, however, has been made for this emergency also. The pontoons are equipped with two or more rings, which can be engaged by hooks from powerful cranes. The cranes, then, would lower the life-pontoon into the sea. But suppose the crew got panicky or there was not sufficient time to do this. Our full page illustration shows what would happen in such an emergency. The life-pontoons would simply be disengaged and would be pushed down into the sea as shown. Of course, the Captain would wait as long as possible before doing so, because the ensuing drop of 40 or 50 or more feet down into the water with a pontoon load of passengers would not be pleasant, and would only be as a last resort.

The launching, however, could be done in such a way that the pontoon would land with one end first, and thereby ameliorate the shock, which, in any event, would not be very great, because the pontoon landing in the moving sea is offered a fairly good cushion thereby. Of course, the pontoon while rolling over and over in the sea for a few minutes would not be a very pleasant thing for the passengers, but remember, that they are strapped in tightly. They might become dizzy and even seasick from the experience, but at least they would not drown or be killed by exposure as is usually the case in the open lifeboat.

All in all, it is to be hoped that a humanitarian device of this kind will soon be installed and become universal. While the design as offered by me may not suit all sea requirements, I am certain that the basic idea as a whole is practical and feasible.

In the illustrations, I have endeavored to show a number of different ways how the life-pontoons can be launched, either by crane or floating off unassisted. There is also one method whereby the life-pontoons might be stored below decks. A hatch would then have to be opened to eject the pontoons.

Possibly the best and only means, however, which in practically all cases would be foolproof is to keep the pontoons on top of the ship and let them remain there until the ship sinks, in which case, the pontoons will float off unassisted, without undue shock and rough handling to the passengers. The only exception is the case of fire, when it may become necessary that the pontoons must be launched.


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VACUUM TUBES AND THEIR CHARACTERISTICS




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# New Safety Lifeboat

*By* Hugo Gernsback

(*Continued from page* 912)

so that the pontoons simply remain resting on top of the ship.

How the ship sinks is of little concern, however, because we know that the pontoons will not be able to sink, and will merely float off as the ship settles into the water. In several illustrations this is graphically shown, and it makes no difference whether the ship sinks one way or another, or whether it even overturns or sinks at a steep angle. It is all the same to the pontoons, which, the minute they get into the water will automatically right themselves and will soon float on an even keel.

### *Action When Ship Sinks*

THERE is a popular delusion that every big ship when it sinks causes a vortex and sucks all objects down. This happens very infrequently, and it is to be doubted that it ever assumes great proportions. For instance, in the sinking of the *Lusitania*, eye-witnesses pointed out that instead of a suction, there was a swell closing over the *Lusitania* at the time she went down. If, however, an occasional suction occurs and carries the pontoons down, perhaps for 20 feet or so, that will not in the least endanger them, and the pontoon will bob right up to the surface of the water like the proverbial cork. Of course, while all this happens, the valve that controls the air inlet of the pontoon is closed by an officer, so that no water can get inside; but just as soon as it comes up to the surface of the water and floats on an even keel, the officer opens up the valve and the air that is needed is rapidly sucked in by means of a special ventilator. By this time, a small 20-horsepower gasoline engine begins operating, not so much for the reason to propel the pontoon to any great distance, but for the purpose of getting away from the wreck and to avoid colliding with other pontoons which surely would be the case if six or eight were floating quite close together, and when disaster to them might occur when two or more are smashed together by a heavy sea.

Of course, when one of these pontoons slides down 30 or 40 feet from the top deck of the ship and plunges into the water, things might not be any too pleasant in the interior of the lifeboat, unless all the passengers were strapped tight by means of life-saving leather belts. If they are strapped tight against the padded walls, little damage will result, and it is far better to have a few bruises and to be shaken up for ten or fifteen minutes than to find a watery grave. It is by far the lesser of two evils.

The life-saving pontoon is not made with any idea of great comfort and luxurious berths. It is simply constructed with one purpose in view, and that is to save life. It will, of course, have on board enough food to last for some days, and it will have other necessities to maintain the life of its passengers and to keep them at least in fair comfort. A good supply of rockets, flares and a small radio transmitter are, of course, most important and all of these can easily be taken care of, because their weight is not very great.

### *Purpose of Pontoons*

I HAVE no idea at all that these pontoons should have enough motive power so that they will reach the nearest land. To do so, would make them entirely too heavy and too cumbersome, as well as too expensive. That, however, is not necessary, because they are only supposed to save life, pure and simple. Equipped with flares and radio, these pontoons are well built and seaworthy enough

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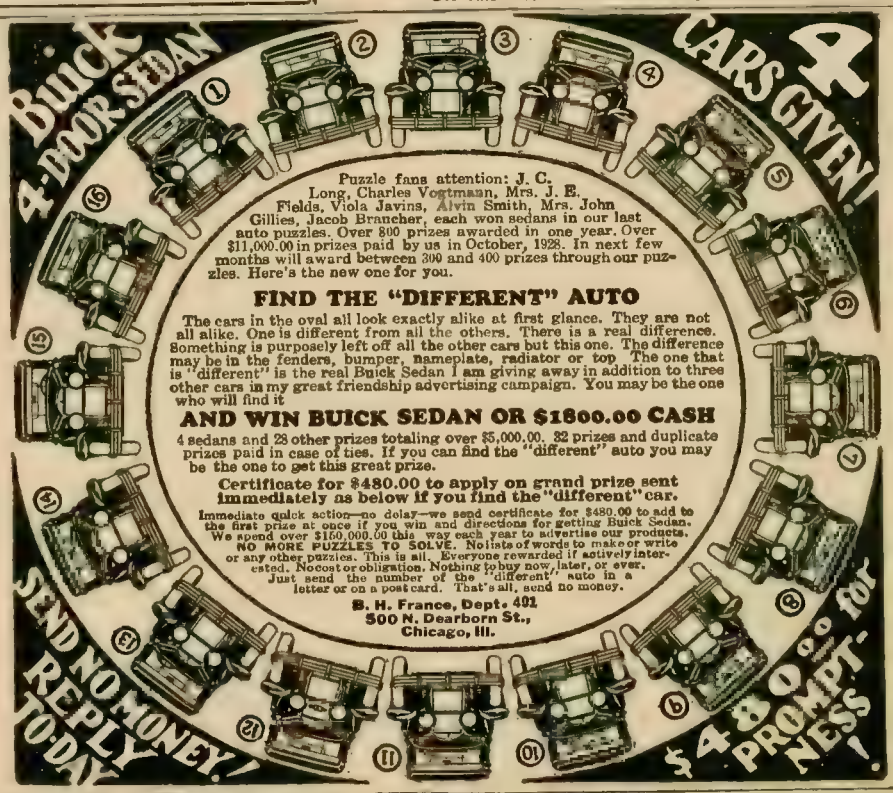


Puzzle fans attention: J. C. Long, Charles Voetmann, Mrs. J. E. Fields, Viola Javins, Alvin Smith, Mrs. John Gillies, Jacob Brancher, each won sedans in our last auto puzzles. Over 800 prizes awarded in one year. Over $11,000.00 in prizes paid by us in October, 1928. In next few months will award between 300 and 400 prizes through our puzzles. Here's the new one for you.

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# Television Light Modulator

*By* Paul L. Clark

(*Continued from page* 951)

the tiny mirror or an oscillating loop, the mirror being vibrated through an exceedingly small amplitude which is just sufficient to valve a *single beam,* so that the aggregate illumination obtained by combining all the light in the bundle of beams, produces a brilliant spot on the scanning disc.

## *Generic Principle*

Figure 1 shows the valve mounted so as to throw the light, after modulation, upon the rotatable scanning disc, and form a spot of white light embracing the field of view; Figure 2 is a plan view of the valve, shown diagrammatically and having *fixed gratings* A and B, the rays being intercepted and varied in brilliancy by reflection from the small mirror which, vibrating under energy responsive to the incoming signals, causes a *luminous grid-like, optical image* of the grating A to vibrate rapidly transverse to the surface of the complementary grating B; so that the degree of registration of each bar and space of the vibrating image, with a corresponding bar and space of the grating B, is proportional to the instantaneous strength of the signal impulse applied to the loop, in the 1-40,000th second constituting a single cycle for the transmission of a single picture area. The lens focusses the rays from the small lamp so that they converge upon the mirror which reflects the several pencils in the form of thin wedge-shaped beams, each about as thick as a sheet of paper.

The grating A consists of, say, 133 bars and 132 spaces per inch, each subtending an angle of about two minutes of arc at a distance of six inches from the mirror, and being about 4-1,000ths inch wide (only six bars and five spaces are shown, for diagrammatic purposes), so that the grating intercepts one-half of the light and breaks the beam from the condensing lens into a bundle of separate, microscopically-thin layers of light which, by a mirror deflection of one minute of arc, are swept through an arc of twice this magnitude, and register upon the bars of grating B to produce a total interception, as in Figure 3, so that no light falls upon the scanning disc and the observer receives a dark area of the transmitted picture.

## *Construction of the Gratings*

Grating A is made by photographing on glass an image of a large, accurately-ruled chart having black lines about 1-8th inch wide. On account of aberration incident to the use of a simple lens or a concave oscillating mirror, the image of the grating A as formed at the plane of the grating B consists of somewhat curved or distorted lines, such as many of us have seen on lens charts in optician's windows. In order to insure that the lines on grid B precisely match those of the slightly distorted image of the grid A, an unexposed photographic plate is placed in the holder of grid B and exposed to the rays which produce the image of the grid A, this plate being photographically developed without disturbing the focused setting.

## *Several Unique Advantages*

1—A spot of pure white light of good brilliancy is secured: 2—Valving is instantaneous and proportional to signal strength; 3—Low power is required; 4—The valved cone may be of large cross-section and wide divergence to secure a bright beam and permit the projection of a sizable picture.



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# Home Movies

*By* Con Bennett

(*Continued from page* 939)

"A tripod screw plate is fitted in the center of the bottom of the case and we use a wooden tripod, in order to get a large supporting surface."

"What exposure do you use with this lamp, Mr. Jones?"

"The exposure depends on many factors, Mr. Blake. The color of the walls will make a difference, a light wall reflecting some of the light on the subject, while a dark will will absorb the light and thus increase the exposure. Again the distance to the subject will affect it as the strength of the light decreases as the distance increases, and not in an equal ratio either. In fact, the light decreases as the square of the distance. If we place a lamp four feet from the subject, we get four times as much light as we would if the light were eight feet away."

### *Building an Arc Lamp*

"I THINK I'll buy one of these small lamps and also make one of the big ones. How about arc lamps? I guess you can't build one of those."

"I built one. Just a small affair but it serves nicely to light a single subject or serves as a backlight."

"Tell me how. I'd like to build one."

"Well, it is not as easy as building the incandescent lamp outfit, but if you have the tools it is a fairly simple job. Here's mine (Fig. 7). The block that holds the carbons is one inch square and four inches long. Two holes are drilled through it, each one-quarter inch in diameter. These are to hold the carbons. At right angles to each hole is drilled a smaller one that is tapped to take a 10-32 screw. On the outside of the block a hole is made to take a square brass nut that serves as a connector between the carbon. The nut is forced into the hole before the hole is tapped so that the screw will run smoothly through both the nut and the block. From the top carbon a piece of copper ribbon is run from this nut to the screw on the socket that holds the resistance. From the lower carbon, another ribbon is run to a small screw tapped into the block. This allows for connecting the other side of the line. (See wiring diagram Fig. 7a.) The resistance is a screw type heater unit that draws 440 watts of current. It is screwed into the porcelain socket that is fastened to the top of the block.

"On each side of the block are fastened the reflectors, two pieces of tin four by four and a half inches. These are bent so that there is a ninety degree angle between them. A quarter inch hole has been drilled in the bottom to take the rod of this table stand I built (Fig. 7b). The stand is made of three-quarter inch wide strap iron and each leg measures eight inches. The rod has been threaded at its lower end and a nut on either side of the leg members makes the stand rigid.

"To use the lamp, I simply put two carbons in place, connect to any outlet, and with a third piece of carbon I strike the arc by touching it to the points of the two in the lamp and then drawing it away slowly. The actual contact is only momentary but it is sufficient to start the lamp operating. To stop, I just pull the cord out of the supply socket. Another socket may be put on the lower end of the base to take a five ampere fuse if you want to be safe, but it is not essential."

"I'm going to build one of those, too, Mr. Jones."


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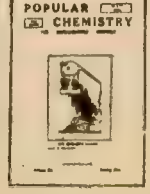


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The fact that man is a slow breeding animal with very small families, it is not possible to study inheritance and sex as thoroughly as with animals where all factors are controllable and large numbers worked on. But in man there are some striking conditions to show we have the same principles, such as color blindness and bleeders as perfect sex linked recessive unit characters.

The writer after these observations and studies believes that sex determination is a chemical and biological problem and can only be so determined, and follows the laws of chance as to the number and ratio of sex determining cells. Dr. Reeder's comparatively few cases compared to the millions in animal experiments simply happened in the error of small numbers and they still follow the biological laws of chance in sex determination.

The interest in sex determination is also shown by the fact that the International Society for Sex Inquiry, whose activities have been in abeyance since 1913, has been reorganized and held an international congress in Berlin the first of October, 1928.

***Dr. Albert Schneider, M.D., of Portland, Oregon, has this to say:***

THE whole subject is an unsettled state. Dr. Schenck years ago declared that feeding sugar to the female would make for females, and starving the male, for males, but there is no satisfactory evidence that he was right. As you say hundreds of theories have been advanced none of which have stood the test. Let *me* spin a few theories:

It is known that the male germ cell, the spermatazoon, is very susceptible to the action of alcohol, the weakest germ cells being killed off first, and the more robust cells surviving even large doses of alcohol. It has been suggested that by means of carefully determined and regulated doses of alcohol, administered internally, it may be possible to kill off all of the weaker male germ cells, leaving only the stronger ones, the more virile, the more actively motile cells, to take part in the fertilization process. After the proper dose of alcohol has been given, a sufficient period of time should be allowed between the time of taking the alcohol and the act of fertilization, to permit the still living and robust but perhaps much inebriated spermatazoa to recover from the spree. It has also been suggested that the more actively motile sperm cells are male creators. If that be so then the inebriation method just outlined should tend to a preponderance of male children. Now, this to me is interesting as a theory but as far as I know there is no experimental proof of the correctness of the theory.

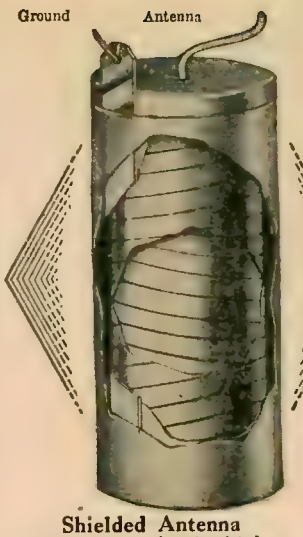
One of the oldest medical papyri (Kahun papyrus—2,000 B. C.) among others, contains directions for determining the sex of the unborn babe. Manoiloff, the Russian scientist, outlines a series of tests by means of which the sex of the unborn babe may be determined.

Some years ago it was taught that the secret to sex lay in the extra chromosome (chromosome X) of the male germ cell, but I believe this theory is largely abandoned or at least neglected.

I shall be interested in the outcome of your inquiry and I sincerely hope something worth while may come of it.

(*More letters in the next issue*)

**If you were asked what are the *"modern wonders of the world,"* what would your reply be? The *seven ancient wonders* are quite well known, but they have rarely been pictured before. In the next issue of SCIENCE AND INVENTION Magazine you will see the ancient and the modern wonders contrasted in striking style.**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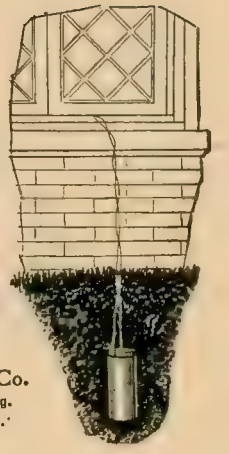

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There are many objects in the picture of the circus above. See if you can find 5 that start with the letter "C." When you do this, write them on a piece of paper together with your name and address and send it to me right away.

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In addition to the Studebaker Sedan, the Chevrolet Sedan, the Victor Orthophonic Victrola, the Shetland Pony and the many other valuable prizes—besides Hundreds of Dollars in Cash—I am also going to give $550.00 in Cash for Promptness. It will pay you to act at once. Any winner may have cash instead of the prize won and in case of ties, duplicate prizes will be awarded. There are no tricks or illusions of any kind and neatness or handwriting does not count. You will not be asked to write in any squares, add up any figures, build words, or solve any additional puzzles of any kind. Get busy right away. Find 5 objects starting with the letter "C," write them on a piece of paper together with your name and address and send it to me just as soon as possible. EVERYBODY AWARDED. Address

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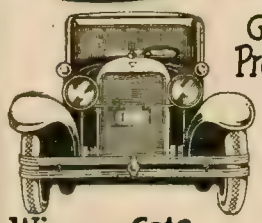

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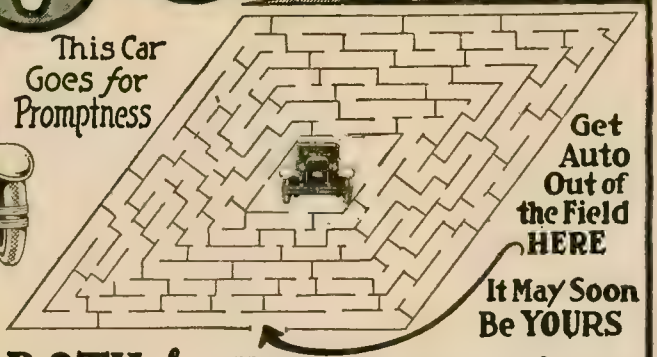

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Solve this puzzle and solve it quick. There's too much at stake for you to delay a minute. Take a pencil and draw a line showing how the auto can be driven out of the field pictured above. There's all kinds of fences in your way and there's only one gate out of the field, but if your eyes are sharp you MAY find a way thru the various gates in the fences, and get your auto out.

**If you find the way out, cut out the puzzle and SEND YOUR ANSWER QUICK**

Some sharp-eyed person is going to win the $1,000 CASH and the auto, too, if on time. Why not you? The Hudson is a Prize for PROMPTNESS. If you win the $1,000 you want to get the Hudson, too. Send your answer, TODAY. We will let you know at once, how close you are to winning, how to get the $1,000 first prize, and make the Hudson yours. There will be no delay in giving you your award for solving this puzzle, so mail your answer AT ONCE.

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## The Answer to the Question —"Can We Control Sex?"

(*Continued from page* 909)

It is therefore important in human as in animal economic life.

Since in sexual reproduction each individual is produced entirely by the combined action of a germ cell of the female form and one of the male form it is necessary for these two very minute units to have within them some form of inner organization that in nature and behavior parallels the exhibition of characters in the resulting body. It now appears that there is no essential difference between the behavior of ordinary characters and those classed as sexual. Indeed there are certain "sex-linked" characters, as color blindness rather complicated but always sex-linked in human inheritance.

One must then consider the chromosomes or small rod shaped bodies in the cells at the time of cell division and these are always definite in number for each species of plants and animals. For more than a quarter of a century now the short-horned grasshoppers have been studied and many genera and a large number of species have been investigated. Geologically they are old. They present evidence of a constant and long-persistent organization. Studying the cells of the individuals, in every cell of every individual in this great group there are 23 chromosomes for the males and for the females 24. Throughout this group there is one particular chromosome which can be recognized through peculiarities of behavior and function, the sex-determining chromosome whose impaired condition in the male makes an odd number of elements.

In the formation of the sex cells the number of chromosomes are reduced to one-half so that in the formation of the new individual he receives one-half of the characteristics of each parent. Therefore in the female the egg contains twelve chromosomes while in the male one-half of the sperm cells contain twelve chromosomes and one-half only eleven chromosomes. If then the egg is fertilized with a sperm containing twelve chromosomes the resultant is a female with twenty-four chromosomes, while if with one containing eleven the resultant is a male with twenty-three chromosomes.

These studies are most difficult but the same time most important. Our technical methods are highly perfected and optical instruments are the best the world has ever known.

Exceptions to this often prove the rule as in cases of disease of the ovary may so cause it to revert as to produce sperm cells. The Free Martin in cattle is a sexual anomaly always coming with twins and never with female twins, but only where the one is a male and the placentæ are united so that the male toxin affects the other.

This is but a brief outline of the findings and theories in animal life and observations in human life but in these cases it shows that there is about an even chance for males and females, and in considering large numbers of figures over long periods of time we find that in both plant and animal the ratio of the males and females is about fifty-fifty proportion. It is only large numbers that show us the truth and we cannot take a few examples and draw conclusions.

One can study animals and secure data that he cannot on human beings, as he can control them and make microscopic studies. The laws of heredity are fundamental biologic laws applicable to every living thing, whether plant or animal. Mendel worked out the principles with garden peas and these principles have been found to hold good, whether plants or animals, whether peas or mice, insects or cows. This must inevitably be so, since all multicellular creatures take origin through fertilization of one cell by another. If the laws of heredity established with peas hold good for mice, they should hold for men, for there is far less difference between mice and men than between mice and peas.

(*Continued on page* 995)



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### *Age of Semen Makes Difference*

IT requires no argument that if the sex of offspring depended absolutely and in a practical way upon the freshness or staleness of semen, the problem of sex control would have been solved. Without discrediting the general truth of the theory, there are certain unavoidable sources of error, due to physiologic limitations. In the first place, after their formation, by the male sexual gland, the spermatozoa have to pass through about twenty-five feet of duct and may further be delayed in a reservoir similar to the gall bladder, before they are discharged. Only an operation, though not of very formidable nature, could provide absolutely fresh spermatozoa and we could not be certain even then that their vitality surpassed that of the female type of spermatozoa. On the other hand, if it were desired to produce female offspring, there would be practical difficulties in the way of getting the spermatozoa at exactly the stage in which the male type would all be dead and the female still active.

During the last part of the nineteenth century, the old ideas as to menstruation, ovulation and conception were discarded by most scientific authorities. It was held that the discharge of the ovum occurred very irregularly and without regard to the menstrual cycle. As the movements of spermatozoa had been observed two or three weeks after their deposit in the female generative passages, it was believed that they were able to fertilize the ovum at almost any time. On the other hand, the rapidity with which these microscopic cells move, was not realized. Thus it was held that the real moment of fertilization bore no close relation to the apparent beginning of pregnancy. According to these views, any regulation of the degree of freshness of the semen would have been impossible.

Nearly coincident with the beginning of the present century, more exact scientific investigations began to swing the pendulum of belief back toward that of the ancients. It is held that as a rule, ovulation does occur at a definite time in the menstrual cycle, and some even hold that following ovulation, a substance is formed which is the real cause of menstruation. But it is now believed that the extremely active changes in the chromosomes of the primitive ovum incident to its division into two, only one of which is perfect, cannot last long and that the ovum must either be fertilized within a day or two after its discharge or it will degenerate. The same argument applies to the spermatozoa, perhaps with a longer time limit but, at any rate, they are believed to have passed the stage at which they can fertilize the ovum within a few days, long before the motion of their appendages ceases.

### *System Not Perfect*

NEVER-THE-LESS, the leeway that must be allowed between the actual discharge of the spermatozoa and the moment of fertilization is considerable, too much to render possible, an absolute reliance on the relative activity of the X- and the Y-containing spermatozoa, according to the freshness of the semen. Some advocates of this method claim 80 to 90 per cent. of success. This is more modest than it might at first appear. Approximately 50 per cent. of successful predictions would result, by the law of chance, even if the method followed had no influence at all. Seventy-five per cent. of successful predictions means that the method followed is 50 per cent. efficient and 80 to 90 per cent. of gross successes in prediction means merely that the method has an efficiency of 60 to 80 per cent. It is by no means illogical to suppose that a method which favors the desired kind of spermatozoon and which considers also the probable date of the discharge of the ovum, should, when added to the law of chance, produce a gross efficiency of 80 to 90 per cent.

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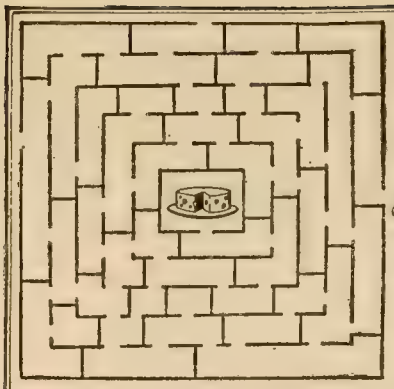

# $415.00 Cash Given

Boys and girls! Here's a chance for you to help this pony get a piece of cake, and get a real live Shetland pony for your own. The pony sees the piece of cake in the center of this puzzle, but he doesn't know how to get it. Can you show him a way? Just draw a line from the pony's nose, through the gates in the fences until your line reaches the cake at the center. If you can find a way for the pony to get the cake without jumping over fences, cut out the puzzle and send your answer to me quick.

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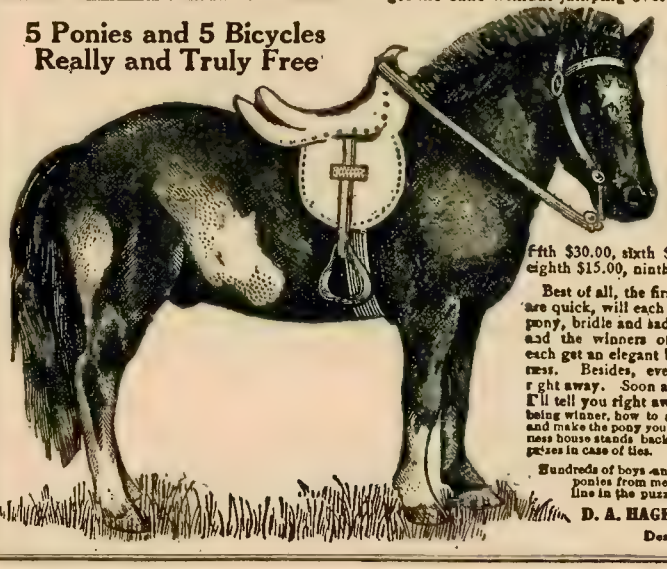

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ratio to be expected by chance, in terms of a race. As stated, some scientists accept this interpretation in the literal sense. But it seems far more probable that it is a difference in mutual attraction between the ovum and the two kinds of spermatozoa that explains this preference. In the primitive spermatozoon the X and Y elements were intimately associated, never could there have been two X elements together until union with the ovum was effected. As in magnetism, the general rule of nature seems to be that there is greater attraction between opposites than between identical things. In plants, we note marked attractions of certain parts by light, warmth and moisture. Relatively, at least, other parts manifest repulsion. In animals, which are generally motile, we note the same attractions and repulsions but they are so readily explained in other ways, that we do not think of them in the same terms. It is possible that the analogy to magnetism may be more than a mere illustration. Magnetism is certainly a manifestation of electricity and those who assert that the force existing in living organisms is electricity will not down. General Crile has formulated a bipolar theory of living processes, depending on differences in electric potential. The division of the primitive spermatozoon and ovum, the chromosomes going to opposite poles, is a particular example of this process.

That there should be a specific attraction between the ovum and one type of spermatozoön, does not seem farther fetched than that there should be an attraction between the ovum and spermatozoa in general. The latter attraction can actually be seen under the microscope. Nor is a relative repulsion between the ovum and one type of spermatozoön more remarkable than the observed fact that, after fertilization, an ovum or even a fragment of an ovum, repels spermatozoa.

### *Some Strange Facts*

IT is quite within the bounds of possibility that with the expenditure of a hundredth of the expert skill and a thousandth of the money that have been applied to cancer, some biochemic reaction can be devised which will absolutely control the attraction between the ovum and one of the two sex-types of spermatozoa. Indeed, this possibility has actually been achieved experimentally, not to the degree of perfection, but as well as most of the details of the cancer problem have been solved. Dr. I. S. Rubin, a former military assistant of the writer, has raised the sex ratio of white rats from 103:100 to 150:100, by injecting a testicular extract.

Recurring to the demonstrated fact that the mortality of ova fertilized with male, Y-containing spermatozoa, is far higher than of those of opposite sex, we have a plausible explanation of the empiric idea that fresh semen is much more likely to yield male offspring than stale semen. *It has been found that semen taken immediately from a frog, and used to fertilize the ova, produces approximately equal numbers of males and females. As the attempt at fertilization is delayed, the proportion of males becomes greater and greater till, after four days,* only males result. This is exactly opposite to the theory as applied to human beings but the principle is the same and it is not strange that one type of sex-chromosome should be more resistent in one animal, the other in the other animal so far removed in the scale of development. *Judicious exposure of hen's eggs to X-rays, similarly increases the proportion of female chicks and ultimately eliminates male chicks altogether.* Or, we should rather say, that the sex-chromosomes are changed in some way for there is no reduction but, on the contrary, a slight increase in the hatchings. But in frogs and toads, certain fishes and birds, the sex chromosomes are not so fixed as in mammals. In frogs, an actual change of sex has been produced, after its apparent establishment.



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# Can We Control Sex?

(*Continued from page* 989)

four chromosomes which are otherwise matched in the X-containing spermatozoon. The chromosomes do not make up the entire bulk of the nucleus and the latter is only a small part of the entire cell. Some have even claimed that the excess of fertilizations with the Y-containing spermatozoon are due to its smaller size and hence greater agility.

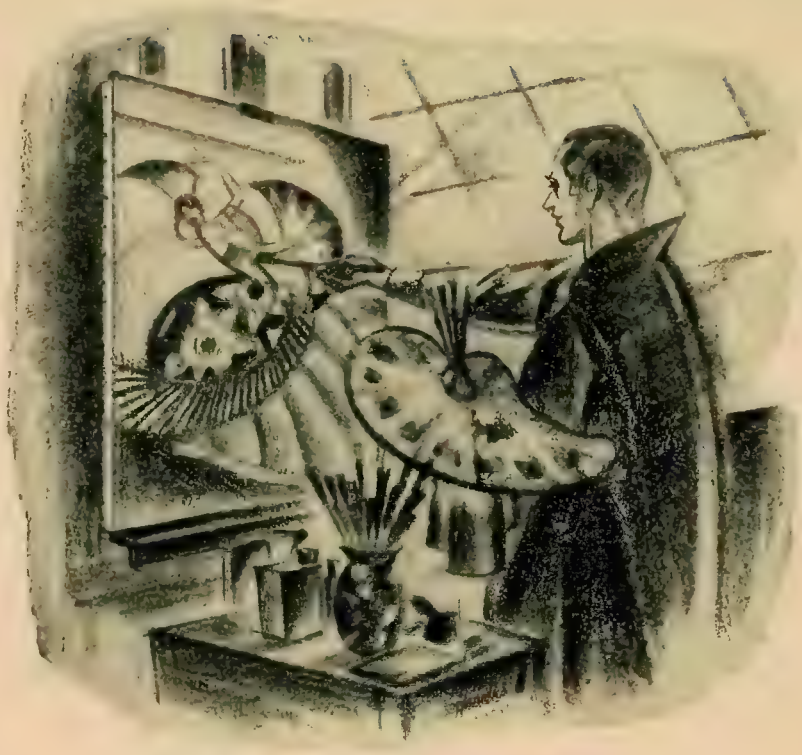
### *How It Can Be Done*

IT is obvious that if we could separate the two kinds of spermatozoa, mechanically, it would be possible to inject either kind at will and thus control sex. The latter part of the procedure involves no great difficulty. Indeed, essentially the same procedure has been employed to relieve certain kinds of sterility. The first part of the procedure would seem impossible on account of the extreme delicacy of manipulation necessary. However, an increase in the power of microscopes to double the present attainments, would render the detection of the different types of spermatozoa fairly easy. Surprising results have been attained in working with blood cells, casts of kidney tubules and other minute structures. A combination of chance and skill may succeed. Some years ago, Dr. Rowley showed a mount of blood in which the different kinds of white cells were arranged (?) in a straight line. I asked if this was done with a toothpick. The question was not entirely a jest for while a toothpick would have looked like the trunk of a tree in comparison with white blood cells, I really thought that the cells had been coaxed into line with some very delicate intrument. The alignment, however, was purely a matter of chance. It is not very difficult at present, to corner a spermatozoon that has wiggled to the outside of a microscope mount and, with an increase in visibility secured by improvement of the microscope, it is not impossible that a few of one sex could be captured.

### *Bio Chemic Separation*

MECHANIC separation of spermatozoa is a comparatively clumsy method in comparison with a chemic or bio-chemic reaction analogous to those applying to bacteria, or to tissues invaded by bacteria, to bloods of different kinds and other developments of modern medicine. When, from hæmorrhage or disease, a man is dying from impoverishment of the blood, he can theoretically—often practically—be restored by injecting blood from a healthy person. But we have learned that human beings have four distinct kinds of blood from the bio-chemic standpoint, though they may appear identical microscopically or even by ordinary chemic analysis. If we inject the right kind of blood in relation to that of the patient, the result is favorable. If the wrong kind is injected, the blood cells are precipitated and the result is very likely to be fatal. Moreover, so far as we know at present, the four kinds of blood have no relation to race, family, or habits of life. Somewhat similar bio-chemic reactions enable us to detect the presence of certain germs in the body or, in the case of diphtheria and vaccination, to determine whether the protective action of such germs has expired, the germs themselves having long been absent. Are such phenomena less wonderful than the imagined separation of the two kinds of spermatozoa, by some kind of treatment with an organic chemical?

The actual separation of spermatozoa may be entirely unnecessary. Indeed, if the proper reaction may be obtained so as to distinguish the two kinds, it is quite likely that the actual separation will be superfluous. We have spoken of the original fertilization of 170 males to 100 females instead of the 100:100

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tinues. At the worst, only two or three per cent. of the population would be killed in actual warfare. We also imagine, at first thought, that war means killing of men. But the general stress and suffering kill nearly as many women and children as men. Finally it may be pointed out that the excess of births over deaths is not very great even in the most prolific races and that an enormous increase in the sex ratio at birth would be necessary to have any appreciable influence on the general sex ratio of the total population, within a short time. The average general birth-rate and sex ratio would ultimately restore a disturbance of population in any direction. It should also be realized that no increase in the births of male infants would compensate, either socially or economically, for the loss of men 18 to 45 years old.

It is evident that if we could bring to perfection, the conditions surrounding the development of human offspring, the population would soon consist of 170 males to 100 females. There could be no ethical objection to this since it is essentially a life-saving method. It is equally evident that the converse procedure, to increase the proportion of females by rendering the conditions of ante-natal life still more dangerous to the male embryos, would be highly objectionable.

Fortunately, neither procedure is practicable, nor desirable. Only a militarist or a hostess in desperate need of men wants to increase the ratio of males to females and only a polygamist or an exploiter of labor could desire an increase in the opposite direction.

### *Why Control Sex?*

THE desire to control the sex of human offspring is not one of the community whose economic and ethical interests are best served by the present near-equality of the sexes, but one of the prospective parents. Sentiment still follows science at a long distance. We may assert that, on the average, each parent contributes equally to the heredity of the child, irrespective of sex; some claim that genius goes from mother to son and other qualities analogously, from one sex to the opposite. But the majority of families still desire a male heir to "carry on the line." Parents who have had only sons, often desire the softening influence for them, of a sister. If the opposite condition exists, we are still old-fashioned enough to feel the need for a man to safeguard his sisters. Tendency toward fatal hæmorrhage, while potentially transmitted through daughters, rarely becomes an actuality except in males. With this terrible hereditary threat, many potential parents would feel justified in refusing to become actually so, unless they could be assured that their offspring would be of the female sex. Just how seriously heredity is to be taken in a practical sense, is still subject to discussion but in many instances, even without the danger of hæmorrhage or of the very few and somewhat doubtful other conditions which occur in only one sex, a man and his wife may take account of their transmissible stock and decide that it would be valuable to a man-child, a handicap to a girl, or vice versa.

At any rate, the problem of control of sex is an individualistic one and, hence, a solution to be of any appreciable value for human beings must be nearly perfect.

Some miscroscopists claim and others deny that there is a visible difference between the potentially male, Y-containing spermatozoa and the potentially female, X-containing. The sceptics concede that the Y chromosome is smaller than the X chromosome but deny that the difference is detectable in the head of the spermatozoon, since the difference applies to only one of twenty-

(*Continued on page* 991)


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tion XY represents a male. Essentially the same phenomenon occurs among birds except that the male produces like cells while the female produces cells with dissimilar sex chromosomes which determine the sex of the offspring. Among insects, some follow the mammalian analogy, some the avian.

### *To Control Sex*

ANY attempt at deliberate control of sex in mammals, including man, must therefore determine that, for a male, the ovum must unite with a Y-containing spermatozoon; and with an X-containing spermatozoon for a female.

We may get a hint from nature. For over 250 years,* it has been known that all accurate vital statistics on a large scale show that instead of the expected equal number of males and females born, there is a slight preponderance of males. The same is true of stock and laboratory animals. Furthermore, we find that in infants born dead, the preponderance of males is still greater; that premature infants and miscarriages show a greater and greater excess of male deaths until for very early miscarriages, the ratio of males to females is 4:1. Still more curious is the fact that at about the fifth year, the number of boys and girls become almost exactly equal although there is no apparent physiologic or social reason why, in early childhood, boys should have a higher risk of death than girls. The proportion of still births and of miscarriages to total births is comparatively small so that it has been calculated that the original fertilizations for human beings is in the ratio of about 170 males : 100 females.

The process of fertilization involves the presence of one ripe ovum and the race toward it of several million spermatozoa, equally divided as to potential sex. If in any other series of races, we found that the expected 50:50 ratio of success was changed to a ratio of 170:100 at the beginning but that the victors lacked staying power and gradually dropped out so as to produce an ultimate equality, we would say that this could not be due to chance and that if we could discover the reason for the initial success and the ultimate relative failure, we ought to be able to control the result at will.

That general hygienic care has something to do with the ultimate sex ratio is evident when we discover that, as a general rule, though with many exceptions in small series of statistics, more enlightened and better nourished races have a higher ratio of male to female births than less fortunate races and that in horses, for instance, the birth ratio is about 96 males : 100 females though the inclusion of still births brings the ratio up to what would be expected for mammals generally.

### *Male Birth Increases After War?*

IT has been held from the most ancient times until since the latest great war that there is a natural, or Providential, compensation for the loss of man power, by an unusually high ratio of male births after wars. I have succeeded in securing statistics that show that this notion is entirely false. There are just the same minor fluctuations of the sex ratio, with a slight but appreciable excess of males, after a war as before or during a war. Probably the old idea arose from a misconception. Off hand, we think of a serious war as killing off a large part of the male population. As a matter of fact, a war fought to the finish means that about a sixth of the forces have been killed. Under modern conditions, no nation can put into its army much more than ten per cent. of its population with an addition of one per cent., for each year that the war con-

* *Sir Matthew Hale "The Primitive Origination of Mankind,"* 1677.

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# Can We Control Sex?

*By* Dr. A. L. Benedict, A.M. M.D., F.A.C.P.

(*Continued from page* 908)

mammals, whose offspring require prolonged gestation, occur singly or at most with two or three at the same time, the span of active life is insufficient for more than ten or a dozen profitable results from the thousands of female cells and billions of male cells formed.

Sexual reproduction in its simplest form makes no further demand upon the parents than the discharge of reproductive cells, even fertilization, as in the case of fish, occurring after the ova have been deposited in some more or less favorable spot. The fertilized ova develop without parental care.

The next form of sexual reproduction, exemplified in the amphibia, requires that the ova be fertilized before their discharge but they are soon deposited and no further demand is made upon the parents.

In birds, various stages are noted, from that in which the eggs hatch with no requirement of warmth maintained by the setting female, to a pathetic approach to human standards, both parents assisting in the incubation of the eggs, the care of the nest and the feeding of the young. This last in one respect exceeds human standards, as it is estimated that a young bird requires its own weight in worms daily. Some birds seem to be strictly and permanently monogamic, never remating even if one bird dies.

### *Reproduction in Mammals*

IN mammals, the development of the ovum up to the stage at which a general resemblance to the adult form has been reached, occurs within the body of the female. The marsupials, indeed, carry their young in an exterior pouch, more or less constantly according to necessity, for some time after birth. The term *mammal* also indicates that the young must be nourished by the milk of the mother for some time after birth while the protection not only of the young but of the mother animal, requires the services of the father for a variable period.

Excepting in animals domesticated by man, it is evident that some prototype of family life and even a pretty close approach to monogamy, must develop as the process of reproduction and the care of the young become more and more complicated. Monogamy implies that the sexes should be nearly equal in numbers. These two conditions exist coincidentally, among the higher mammals generally, except where the selfish interests of man have led him to assume the protective duties of the males among domesticated animals or have led him to sacrifice some of his own kind in establishing polygamy.

In all organisms having sex, the law of chance would be expected to yield equal numbers of the two sexes. There is also a physiologic reason for this expectation. The primitive reproductive cell produced by the glands of male mammals, contains beside the pairs of ordinary chromosomes, a final mismated pair. As the primitive cell divides, it therefore produces two unlike cells to participate in the reproductive union. The primitive ovum, produced by the ovary of the female, also divides into two but all of its chromosomes are in matched pairs so that the final cell ready for reproductive union is always the same. As a matter of convenience, we say that the male reproductive cells originally contain the sex chromosomes XY and the female, the chromosomes XX, the latter really appearing to be the same as the X of the male cell. Now if, in reproductive union, we have the combination XX, the offspring is a female while the combina-

**Cape Cod Chest of Drawers**
*See LePage's Book, page 3*

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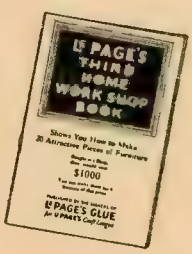


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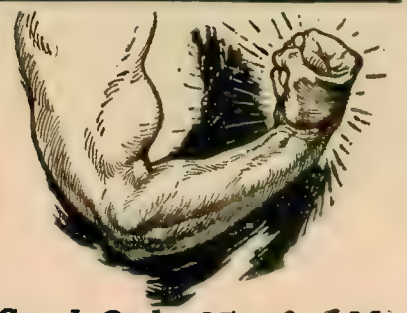

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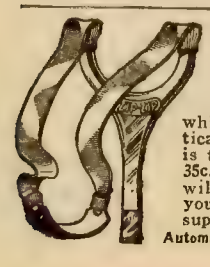

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tion of the genuine parchment. A piece should be cut to the right width, and long enough to reach around the wooden rings to which it is to be attached, allowing about ½-inch extra for lapping. If a design is to be used, it should be painted on at this time. Another suggestion is that old-time prints be secured and pasted in place. The writer used some silhouette figures which he painted in with black India drawing ink.

After this feature of the work has been done and the designs have been allowed to dry, the paper should be further prepared by giving it a coat of half and half linseed oil and turpentine. If a darker tint is desired, a small quantity of asphaltum varnish added to the mixture will give a very pleasing parchment-like tone to the paper. When this is dry it is ready to be stretched around the rings and glued in place. Wood glue must be used for this, and thumb tacks to hold the paper in place while the glue is setting will be found of considerable help. The lap will prove to be the most troublesome part of the job, and can probably be best done by careful measuring and glueing before attaching to the rings. A heavy weight along the joint will hold this while it is setting. The upper ring should be attached to the cap with screws after finishing, from the inside, and the shade set down over the bulb and socket and into place in the base of the shade.

### *Finishing*

IF a hand-rubbed varnish finish is desired, a coat of stain followed by one or two coats of thinned shellac, and that to be followed up by two or more coats of rubbing varnish, carefully rubbed down with pumice stone and oil will give a beautiful job. If a painted finish will fit in with the furnishings better, lacquers or enamels come in a wide variety of colors and will give a beautiful and ultra-modern touch to the lamp.

Next month we expect to give the readers of these articles directions for constructing an "antique" sewing table, parts of which are to be turned and the design of which was copied from a genuine antique of more than a hundred years ago; so save up your mahogany scraps and get ready for next month.

---


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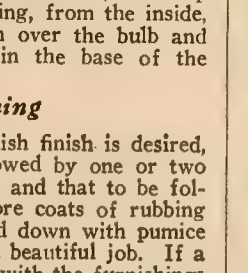


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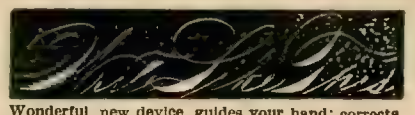

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# Wood Turning

(*Continued from page 983*)

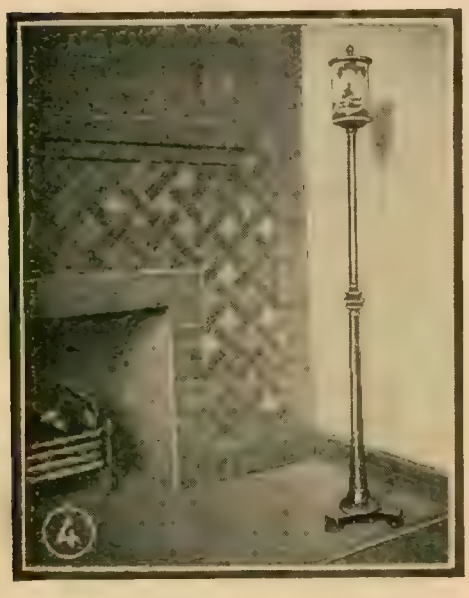
*The two wooden rings, one for the top and the other for the bottom of the lantern, are shown above.*

explained in these articles. The knob may be turned with the cap or in a separate job as illustrated. After parts E, G and H have been prepared, we are ready to consider the rings to which the parchment is attached. Ventilation must be provided and it may be provided in one of two different ways. Perforations may be made in the parchment itself and can be so arranged that they will become a part of the design or as an alternative, grooves may be cut in the upper ring above the line where the parchment comes. A hole must be bored through part E in order to care for the pull chain of the chain socket. This hole in combination with the holes either in the cap or the shade will give proper ventilation for an ordinary forty or sixty watt lamp.

These rings must be fitted loose into parts E and G in order to care for the thickness of the parchment that goes around their edges. If desired, dowels may be fitted into the bottom ring, to set into part E, making the shade more stable.

### *Preparation of the Parchment*

LAMP shade parchment may be purchased ready prepared. There are other lamp shade materials also that may prove preferable to the parchment, however, in case one wishes to prepare his own "parchment," as the writer did, it is easily done and the results are very satisfactory. Purchase a piece of a heavy grade, best quality drawing paper, either in the buff or white. If buff can be secured it will save coloring later, in imita-



*The completed lantern type floor lamp is shown here and contributes an added appearance to the room in which it is placed.*

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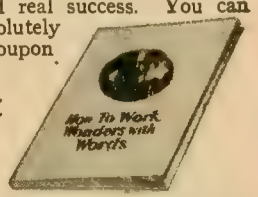


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.....Like a razor also, the pendulum was massy and heavy, it was appended to a weighty rod of brass, and the whole *hissed* as it swung through the air. I saw that the crescent was designed to cross the region of the heart. Down—steadily down it crept. The rats were wild, bold, ravenous, their red eyes glaring upon me. And then.....

From "The Pit and the Pendulum."

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# Wood Turning

*By* H. L. Weatherby

(*Continued from page* 945)

the bottom side of these for attaching to the base, or they can be mortised into the base. The first member of the upright, part A, should also be fastened to the base with screws from below. Holes should be bored in the centers of part A and also the base to permit the cord to be carried up through the post from the bottom of the lamp.

*The above photo shows how the pieces for the post are glued together with a groove in the middle.*

### *Assembling*

ALL parts should be fitted close during construction, and very little trouble should be experienced in gluing the different sections together. Extreme care must be taken to get the sections lined up so that the post will be straight. All wooden plugs should be bored out with 3/8-inch bit before assembling and as an aid to gluing a 1/8-inch iron pipe, which is 3/8-inch outside diameter, threaded at both ends, may be driven down through the whole length of the post. A nut should be screwed on the bottom end of this pipe and a chain pull screw socket on the upper end. Screwed tight, these will pull the different members together.

In case a full length pipe is not used, a short section, six or eight inches in length threaded on the top end, should be driven into the hole at the top and a chain pull socket screwed onto this. This 1/8-inch pipe will accommodate the average fixture cord and, as said before, can be used through the entire length of the post if desired.

This phase of the work, assembling of the post, will, of course, include the base to the shade, part E, also; the construction of which we will consider under the next division.

### *Preparation of the Shade*

THE base and the cap for the shade are turned in separate pieces and the work is done on the face plate. Since the under side of the cap, part G, and the top side of the base, part E, are cut out to accommodate the two rings shown in the detail drawings, the work will have to be centered twice or chucked, both of which processes have been

*The turned base top and bottom portions for the lantern are shown above. The base and cap for the shade are turned in separate pieces and the work is done on the face plate.*

(*Continued on page* 985)


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# Patent Advice

(*Continued from page* 980)

even if your instrument were manufactured and sold, it would be difficult to find the customer. You also did not think of the difficulty of teaching another man to use this instrument.

We would suggest that you demonstrate how your instrument can be operated to various individuals who are interested in sheet metal trades. Get individual orders from these people, and even if you do not manufacture the product for them, take your orders to some large organization and on the strength of them, try to sell the idea. Such a plan may work, but we would not hold out any great hope for the sale of this invention.

## Windshield Protector

(1154) Alexander L. Bernal, San Francisco, Calif., has designed a windshield protector in which a wire curtain drops down in back of the windshield at the instant an auto accident occurs. He intends that it protect passengers from flying glass. He asks our opinion.

A. 1. We do not believe that your idea for a passenger protector would be of value because we do not think that this will operate quickly enough. Generally, in cases of a severe smash-up the windshield shatters so quickly that it is scarcely likely that a screen could be made to fly upward or downward rapidly enough to protect the occupants of the automobile from flying glass. With the present bullet-proof and non-shatterable glass available for automobiles, we scarcely hold that a system of the type you have indicated is of value. We also do not believe that any automobile manufacturers would incorporate an idea of this nature in their automobiles because the system depends upon springs for its action and springs are likely to get out of order very easily. A constant test would have to be instituted to determine whether the device operates. We advise no further action.

## RULES FOR MODEL CONTEST

(*Continued from page* 936)

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2. Models of all kinds may be entered. They may be working models or not, according to the subject that is being handled.

3. Models may be made of any available material, preferably something that is cheap and easily obtainable.

4. Models must be submitted in all cases. Good photographs are also highly desirable, and where the maker does not desire the model to be taken apart, legible drawings with all dimensions covering parts that are not accessible must be submitted.

5. Models should be securely crated and protected against drainage in shipment and sent to us parcel post, express or freight prepaid. Models will be returned when requested.

6. Models for entry in any particular contest must reach this office on or before the 25th of the third month preceding date of publication. For instance, models for the December contest must reach us on or before the 25th of September.

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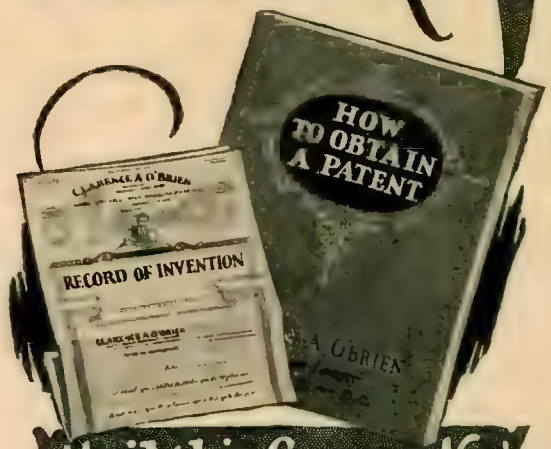


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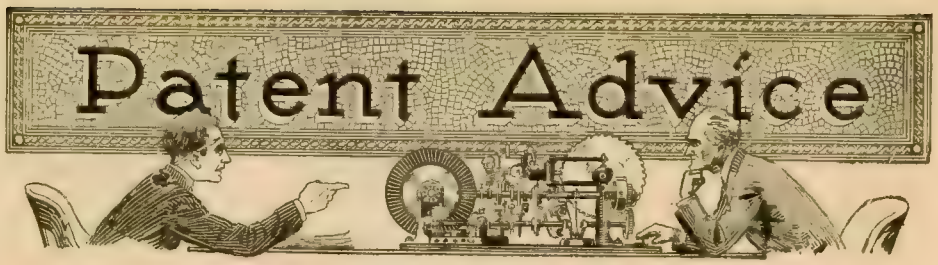


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NOTE:—Before mailing your letter to this department, see to it that your name and address are upon the letter and envelope as well. Many letters are returned to us because either the name of the inquirer or his address is incorrectly given.

## Static Eliminator

(1150) Harry Pierson, Milwaukee, Wis., suggests a method of eliminating static in radio receiving sets. The nature of the questions is made clear in the answers.

A. 1. Unfortunately, static is not purely sound. Static is an atmospheric electrical discharge. Radio waves are also of an electrical nature, but the static electrical disturbances superimpose themselves on the radio receiving system at unexpected moments. There is nothing so far which will filter this static charge out and yet permit the current to pass along the antenna. Static can be grounded the same as any other radio wave. It passes along the wire directly to ground or water. Static will pass through a vacuum as easily as a radio wave and perhaps even more so because the discharge is frequently stronger; but in spite of this, a vacuum tube placed in series with the ground and the antenna will only ground heavy static charges, but will not prevent those static charges from making an audible sound in the loud speaker of the radio set.

Inasmuch as magnetism passes easily through a vacuum, any speaker unit enclosed within a vacuum will affect the diaphragm on the outside, and inasmuch as the static charges likewise affect the magnetism in the speaker unit, the diaphragm will respond to the static charge the same as it does today, there being practically no diminution in strength other than that resulting from a diaphragm being placed further away from the core, as your diagram discloses. In this way not only will the static be weaker, but the volume of the music will also be lessened. Placing the aerial in a vacuum will not help one single iota.

You have based your ideas on false assumptions; namely, that static is sound and that radio is electricity. Fundamentally, the two are electricity. The difficulty is in separating them and in diminishing the static charge so that it shall be weaker than the signal strength. At the present tme it is frequently more powerful. Perhaps super-power transmission will eventually accomplish this.

## Snake Guard

(1151) A. Dais, San Francisco, Calif., has designed a snake guard and asks our opinion of same.

A. 1. The suggestion for a snake guard which you designed might sell. On the other hand, the product might not take at all. While the writer knows a great many campers, he doesn't know of any of them who fear sleeping on the ground because of snakes. More of them object to spiders and ants than they do to the snake.

We believe that an invention of this nature requires considerable advertising to carry it across. Furthermore, you cannot prevent other manufacturers from making a similar product. You cannot patent an idea because of the nature of the material which you employ. It is necessary that the construction itself be patented, and it is very doubtful whether you can get a basic patent on such a product, because the same suggestion is already applied to a different use. Your greatest possibility of sale lies in extensive advertising and being the first one to market a product of this nature. For this reason we have omitted to give the details of your method in this manner in accordance with our usual policy to help and protect the inventor. Priority here would help you but little.

## Relay for Light Circuit

(1152) Gilbert Burras, North Fairfield, Ohio, asks about patenting a relay for controlling electric lighting circuits.

A. 1. There is very little call for a system whereby the light may be turned on and off from half a dozen different sources. While it is true that your relays will do this, and also that ordinary bell wire may be used to wire the relay circuits, it would be just as expensive to install the relays or replace them in event that they failed as it would be to employ several switches and a multiple light circuit.

We frankly do not see the reason or excuse for a product of this type and certainly would not advise that you apply for a patent on the same.

## Drafting Instrument

(1153) E. F. Fales, Sr., Wilmington, N. C., has patented a drafting instrument for use by metal workers. He asks what he can do to sell the idea.

A. 1. When you patented your idea for a sheet metal drafting instrument, you probably did not take into consideration the few individuals who might find it useful. You did not look forward to the remote possibility that you could not reach these individuals and that

(*Continued on page* 982)

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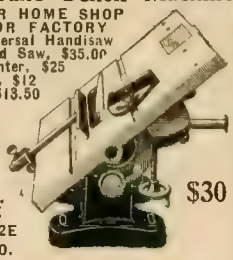

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# Jupiter's Moon in the Making

*By* Donald P. Beard

(*Continued from page* 919)

At any rate, it is hard to avoid the inference that they were the outcome of similar phenomena.

*Fig. 6. Bolton's resumé of drawings by various observers showing structural deformations in equatorial cloud currents in the neighborhood of the Red Spot, and changes in form of the latter.*

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action whatever. If the optical density of the medium is greater than that of the lens, the characteristics of the lens would be the reverse of what they would normally be in air, which of course has a lower optical density than glass. If a hollow concave lens were used under water the lens would have a lower optical density than its surroundings and hence its characteristics would be of less effect than those of a concave glass lens surrounded by air. Therefore such a lens would magnify objects when used under water.

### A Submarine Magnifier

The optical density of water is much nearer that of glass than that of air. If therefore, a lens is used under water the bending or refraction of the rays passing through it will be less than it would be if the lens were used in air. A magnifying glass will therefore lose some of its magnifying power when used under water.

### Bacteria and Sugar

Bacteria, like many other lower forms of life, are one-celled organisms containing a minute bit of jelly-like substance called protoplasm. If the cell is placed in distilled water the water will penetrate the cell and increase the pressure within the cell considerably. If it is placed in a dilute sugar solution both water and sugar will penetrate the cell but the change in pressure will be more gradual and will be reduced by water escaping from the cell. A normal process may thus take place which is essential to the life of the organism.

If, however, the solution surrounding the cell is too strong, the escape of water from the cell will be more rapid than is its penetration. The cell will then dry up and die. This is the preservative action of sugar in the canning of fruit.

### The Pipe Organ and the Piano

If a piano is tuned in a cold room the pitch will be flat when the temperature rises. This is because the piano wires become a little more slack at higher temperatures. The pitch of a wind instrument such as a pipe organ becomes sharp with increase of temperature. This is because the velocity of sound in the pipe increases with increase in temperature while the length remains nearly constant.

### Hearts

The frequency with which one would throw *hearts* in a game of this name is equal to the total number of ways in which this combination of letters could appear divided by the total number of ways in which the dice could be thrown. Let us number the dice 1, 2, 3, 4, 5, and 6 respectively. Number 1 could fall in any one of six different ways and still contribute to the word *hearts*. Number 2 could then fall in any one of five different ways and contribute to the combination. Number 3 could fall in four ways, number 4 in three, number 5 in two, and number 6 in only one. The total number of combinations or ways in which *hearts* could be thrown would then be 6 x 5 x 4 x 3 x 2 x 1 or 720 different ways. But it is possible for each die to fall in six different ways and for all six to fall in 6 x 6 x 6 x 6 x 6 x 6 or 46,656 different ways. Therefore the frequency with which one would throw the combination *hearts* is 720 times out of 46,656 or about once out of every 65 throws. 64 s

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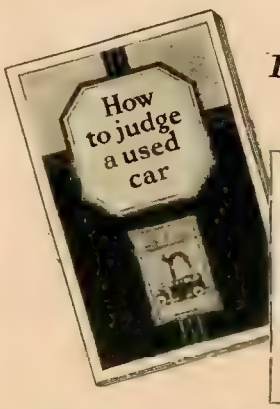


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# Answers to Scientific Problems on Page 934

## A Problem in Displacement

THE floating bottle will displace its own weight of the liquid in which it floats. The submerged bottle will displace an equal volume of water. But since the glass in the bottle weighs more than the water which it displaces, it is evident that the bottle will displace more water while floating than when full of water and submerged. If then the floating bottle being submerged was to fill, the water level will go down a little.

## The Flutes

Many people think that the pitch of a flute depends only upon the position of the holes. The holes do, of course, determine the approximate pitch but the size of the openings is important as well as the position. To give the same pitch a small opening is placed a little nearer to the mouthpiece than is a large one, as is shown in the diagram.

## Well Water

Probably most people think that well water is colder on the average than the air at the surface but in winter it is certainly warmer, especially in freezing weather. Measurements have shown that the temperature of well water is less and less as one digs deeper into the ground until the level of coldest water is reached (usually from 40 to 70 feet). From then on it gets warmer, due to the interior heat of the earth. The temperature of the coldest water, however, averages a few degrees warmer than the air at the surface. This is due to the fact that the earth receives its heat from a very hot body, the sun, but radiates it as a much cooler body. Hence, according to principles of radiation, the earth will absorb heat from the sun until it is hot enough to radiate heat as fast as it receives it. The air also shares in this process of absorbing and radiating heat but it is a much poorer absorber and radiator of heat than the earth, hence its average temperature is a little lower.

## The Fish and the Boy

When light travels from air into water the light is bent or refracted downward at a sharper angle at the surface of the water.

*Diagram showing how optical refraction causes boy to appear taller than normal to fish under water.*

The accompanying diagram shows that this refraction will make a boy appear taller when seen from below the surface than when seen from above the surface. When the boy is directly above the fish the boy will appear to be four-thirds his natural size.

## A Hollow Concave Lens

The behavior of lenses depends upon the medium in which they are user. If the optical density of the medium were the same as that of the lens there would be no lens


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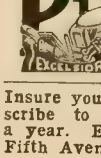


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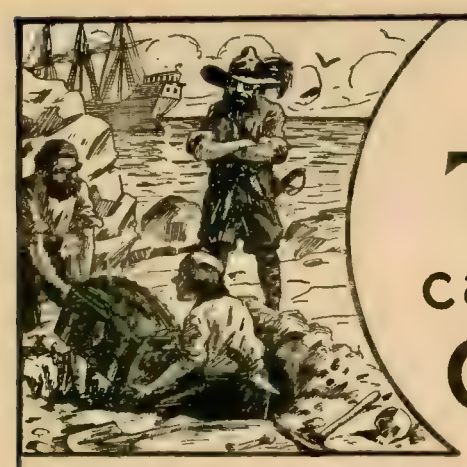

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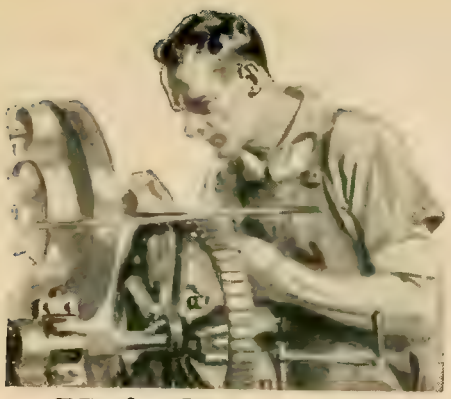

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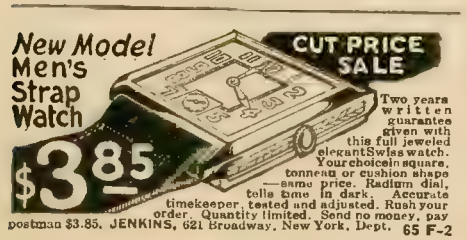


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# Everyday Chemistry

*By* Raymond B. Wailes

(*Continued from page* 941)

1. Yes, seeds breathe in a way. In other words, they assimilate oxygen of the air and give off carbon dioxide, just as is done in the human being. This the seed continues to do as long as there is any vitality left. Seeds have been known to live for hundreds of years.

2. Yes, water will put out fires much more easily if common chemicals, such as salt, sodium, acetate, etc., are dissolved in that water. A stranger fact still is that the effect is the same if potassium chlorate is used. This, despite the fact that potassium chlorate contains much oxygen and should seem to make the fire burn more fiercely.

3. Peanut shells are found of value in polishing of plated wares. They are also employed in the manufacture of explosives, and because of their nitrogen and fiber content they are used in fertilizers. Roofing materials and pressed and molded toys are made with them.

4. The assorted colors of resurrection plants are not natural. These plants, which open up and seemingly grow when put into water and which again shrivel up when taken out of water, are now dyed with various colors to make them appear more attractive. These colors are not produced by the plant itself.

5. Case-hardening powders or compositions into which heated tools and implements are thrust to make them hard contain about 10% charcoal, lime and barium carbonate. Sometimes cyanides are added.

6. Statues literally dissolve because of coal fires. The sulphur gases from burning coal work havoc with metals and masonry. In the presence of water, acids are formed which destroy metal roofs, cornices, statues and other objects of thin metal.

7. When potatoes are not covered with dirt when growing, they produce solanin, due to the fact they play the part of leaves in the sunshine. In other words, the potato is sun scalded. This solanin in the cooked potato is of a dark color and produces a bitter taste.

8. Yes, water is actually formed when gas burns. You can demonstrate this easily by placing a cold pan on a gas flame, and you will see moisture-like dew form on the pan because of the condensation of water present in the product of combustion. Hydrogen or compounds containing hydrogen in the gas burn and form water vapor.

9. Yes, when cotton is put into water it absorbs and adsorbs water, and curiously enough it becomes warm.

10. An ink which is fairly permanent and which can be made at about 1c a quart is obtainable when water-soluble nigrosine, a cheap dye, is dissolved in the water. Water-soluble aniline black is another name for this dye.

11. Butter when turning rancid really shrinks. The same is true of fats. When turning rancid, the butter becomes converted into volatile substances, such as the aldehydes, which escape into the air. This is the cause of the shrinking.

12. Every lawn contains grass and weeds, and grass and weeds also contain tannic acid. The tannic acid attacks the iron of the lawnmower and produces iron tannate, which is black. This is really ink, for many inks are made with iron and tannic acid combinations.

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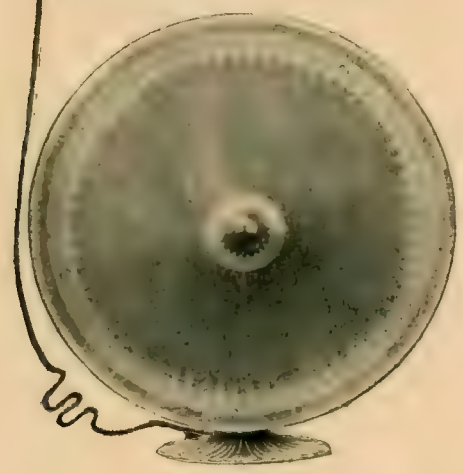

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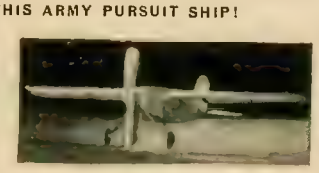

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# Motor Hints

(Continued from page 970)

As a test means for locating defective operation of individual cylinders the spark plug grounding switch, shown in the attached drawing, is a fixture meriting consideration.

This switch can be made from simple parts in an hour or so of spare time, by any mechanically inclined owner.

By means of the test switch, all except one cylinder of the engine can be made inoperative, and a shift can be made quickly from one cylinder to another for comparative operation. The note of the exhaust from each cylinder of an engine should be the same, otherwise any cylinder differing in regularity or note, is the cylinder requiring attention.

While this switch is shown for a four cylinder engine, the reader will readily note that it is easily made for the six cylinder type. The spacing between the contacts and the width of the switch blades should be made so that the switch will allow all cylinders to fire, in an intermediate position.


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### RADIO WRINKLES

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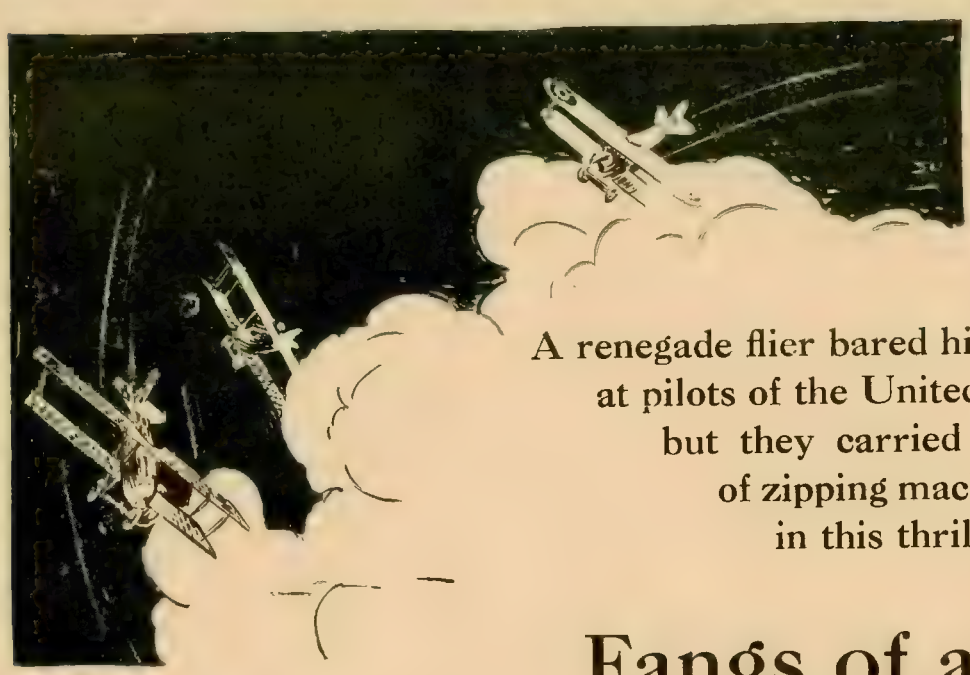

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## Motor Hints

Conducted by George A. Luers

(*Continued from page 933*)

5—Patch all small cuts immediately, to avoid water in the fabric causing rotting.

6—Keep all brakes adjusted evenly. One wheel gripping more than the others will quickly cause this tire to have a flat spot extending through the layers of the tire.

7—Use chains when necessary, but do not have the chain so tight it cannot creep around the tire.

8—Never use chains if road is dry or if driving on concrete in a light rain. Never use heavy truck chains on light type tires.

9—Avoid severe jolts, sharp, jagged edges of concrete, skidding quick starts and quick stops.

10—Keep the tire pressure always above and never below that specified by the manufacturer.

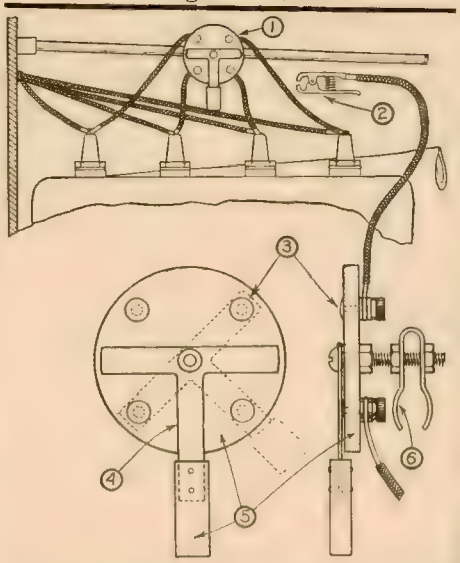
The need of sufficient pressure in the tire and repairs of small tread cuts and tube punctures by vulcanizing, are of foremost importance.

Owners who have small vulcanizers can use these on the large low pressure tires and tubes, employing the methods shown in the sketch.

To vulcanize the tube it is doubled over as shown. To vulcanize a tire cut, use a block inside the tire casing to bring the rubber against the vulcanizer and a good job will result.

A vulcanized tire cut keeps out water and dirt. If water enters a tire in winter, the freezing of the water constantly enlarges the hole apart from the decay of the tire fabric. It is advisable to spend an hour or so occasionally vulcanizing the cuts, which time so spent adds thousands of miles to the tire life.

## Grounding Spark Plugs for Engine Test




*In the above illustration, 1 is test switch; 2, spring clip; 3, contact points; 4, brass switch blade; 5, insulating material and 6, ground clamp.*

For engines that do not idle evenly or do not pull steadily when travelling slowly, the usual remedy is that of removing the cylinder head, grind and adjust valves, adjust carburetor and set the breaker points in the distributor. One cylinder may be responsible for the erratic running of the engine; however to locate the offending cylinder, the above work is usually the roundabout method of correction.

(*Continued on page 972*)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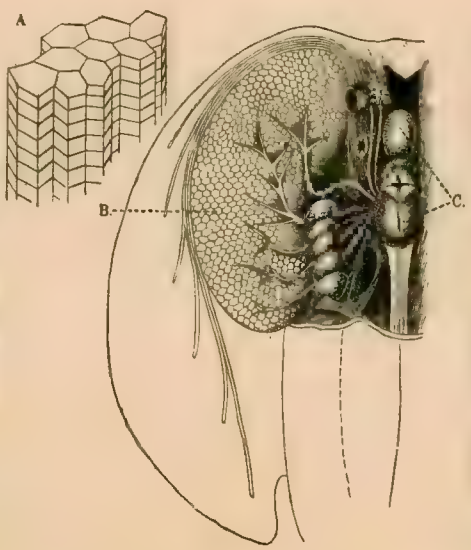
# All About Electric Fish

(*Continued from page 966*)

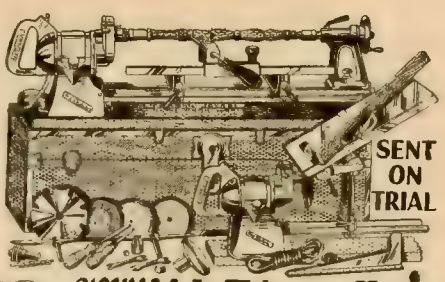
and a second smaller plant lies under the larger one but this does not quite reach the tail. Due to this multiple generating structure, the muscles of the body are displaced toward the back or top of the fish. Even the muscles for the fins hardly have enough room. The generating organs, which meet in the center of the body, resemble flat prisms placed horizontally with the body, and are quite long. The band-like plates are vertical.

The number of plates have been calculated to vary between 6 and 8,000. The plates near the tail are provided with many nerves, those near the head with a gelatinous substance in which the blood vessels are found. Here the entire form of the generating plant may be likened to a set of batteries linked up in series so that the sum total of the voltage given off is proportional to the total number of individual plates found in the fish. This gives this creature its vast electrical discharge shock.

Any electric fish, after discharging its current for a number of times, becomes exhausted and it requires rest before it may again give its total electrical energy. When the nerves leading to the plates or batteries are cut, an open circuit exists and no discharge takes place. But it is peculiar that these animals are not affected by their own discharge for the total current must pass through their body. Even outside electrical discharges have no effect on these fish although other animals are strongly stimulated. If a number of electric fish are placed in one aquarium, and one fish is induced to discharge its current, the electrical energy will not affect any of the fish, but the current may easily be detected as a strong shock by the finger held in the water at a distance of three feet from the fish. Here we have a case where a creature is immune to one of the powers of nature, a power to which other animals succumb.




*The above illustration shows the electric generating organs in the Torpedo marmorata. A are the six-sided prisms and B shows their location in the wing-like projections of the fish.*

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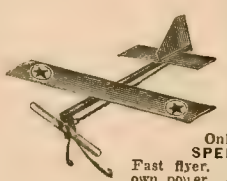

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# All About Electric Fish

(*Continued from page* 964)

*marmorata.* Still other species have fewer prisms and the least number are found in the Japanese form of *Torpedo diterygia,* which only has about 180 of them. The strength of the discharge generated depends entirely upon the number of columns present. The greater their number the stronger the shock.

The electric catfish of the Nile is able to develop 200 volts. The organ of generating current surrounds the entire body of the fish and is found just below the skin. It consists of numerous plates on stalks and into each stalk a nerve fibre enters. About 2,000,000 of these discs or plates are present. At each discharge the current passes from head to tail and returns through the water. The discharge is seldom a simple affair, it usually consists of a rhythmic discharge or set of impulses, there being a definite interval between each shock. The single impulse of one disc is only .4 to .5 volts. The entire discharge is strong enough to produce a spark, when a wire spans head and tail. The current is also of sufficient intensity to influence a magnetic needle, to decompose an acid metallic bath and to vibrate a telephone receiver.

The most powerful electric shock is produced by the electric eel, which, by the way,

*Above is a top view of Torpedo marmorata. The electric organ consists of a number of irregular six-sided prisms, 600 of which are found in this fish.*

is not an eel at all. This fish generates as much as 300 volts, quite sufficient to paralyze small animals instantly, and to kill by repeated shocks through heart failure. The effect of the current is the same as that of any high potential shock.

In its native home, South America, the electric eel is much feared. The fording of a stream where these fish are numerous is attended with danger, for the shocks of these distributed "Trambladores"—as these creatures are called in Venezuela—are so violent that horses and beasts of burden which receive a number of such shocks, fall over into the water dazed and drown. Karl Sachs, who first studied these animals in their native home, accidentally dropped one of these fish which he had caught across his feet. This closed the circuit and the fish could give him a number of shocks in succession of such violence that he involuntarily cried out and remained transfixed for a few seconds, while the "eel" then flopped back into the water.

This fish attains a length of four feet. The head and the body cavity take up little more than 1/5 of the entire body, the remaining 4/5 are taken up by the generating plant. In order to make as much room as possible available for the latter, the intestines are bent toward the front and end near the head. The generating plant ends at the tail

(*Continued on page* 968)


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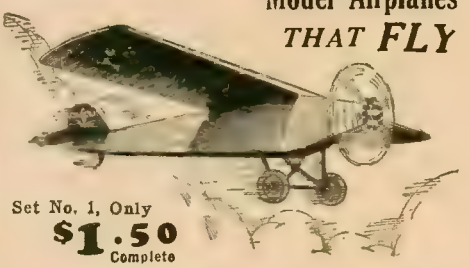

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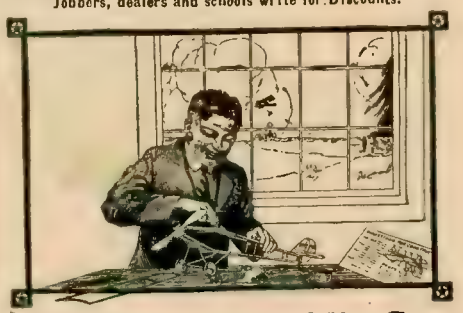

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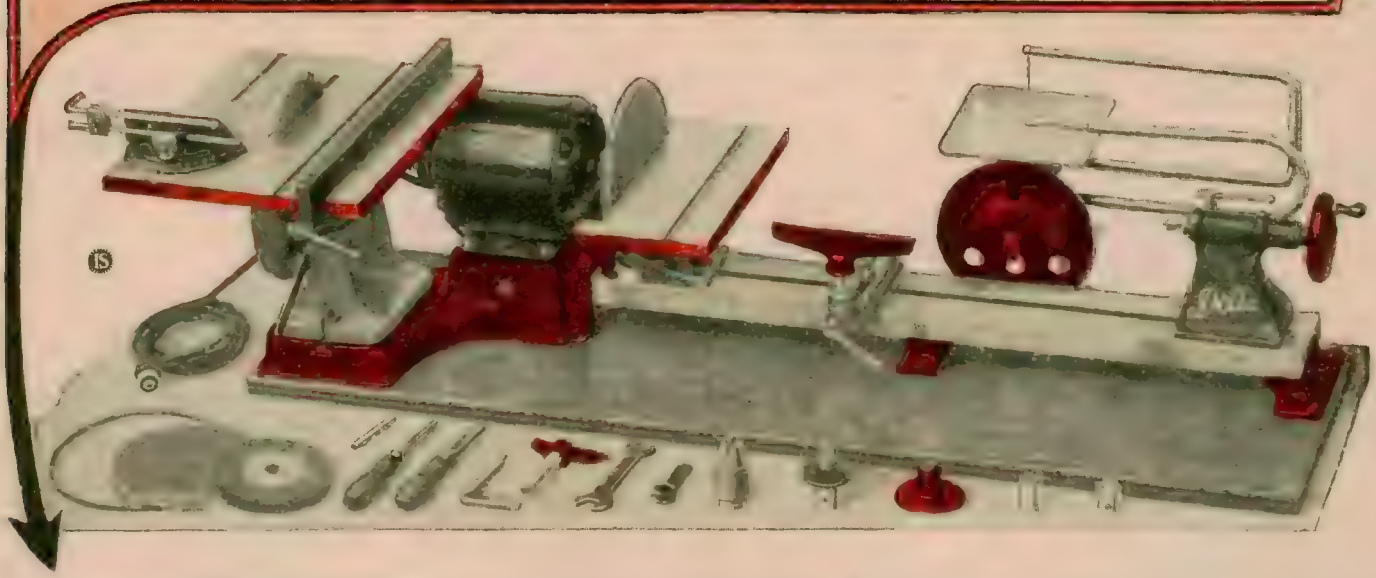

## New Features of 1929 Model

found *exclusively* in the "Delta" Handi-Shop, in addition to the many regular exclusive advantages, make this shop one of the finest values in the workshop field. A few of the new improvements are:

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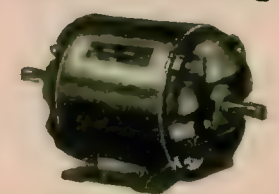

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## All About Electric Fish

*By* Dr. Ernest Bade

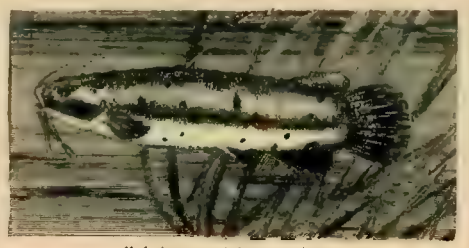
*(Continued from page 932)*

most 15 volts may be developed, but this is exceptional.

As much as 30 to 80 volts is developed by the torpedo, a fish inhabiting the warmer parts of the ocean. The current is strong enough to light an electric bulb weakly, but

*Above is a cross-section of a Torpedo marmorata. This fish inhabits the warmer parts of the ocean. Note winglike projections on both sides of the body which contain the electric organ.*

the discharge is not powerful enough to injure other sea animals. The electric organ is situated in the winglike projections on both sides of the body. In shape the organ is like a kidney and it fills the part of the body it occupies. The organ itself consists of numerous irregular, six-sided prisms placed vertically and close together. They



*Above is a picture of Malopterurus electricus, another electric fish.*

give us a complete picture of cylindrical galvanic batteries of paired elements. The fish, scientifically known as *Torpedo occidentalis Storerm*, contains 1,000 of such columns. The same number of prisms are found in *Torpedo hebetans Lowe*. Eight hundred prisms are found in *Torpedo californica*, while only 600 are found in *Torpedo*

*Above is a view of a dissected electric catfish. H is the outer skin, E are the electric organs, and N, the nerves.*

*(Continued on page 966)*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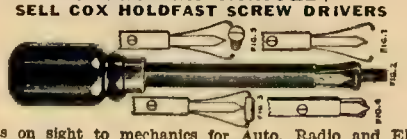

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# Shattering the Atoms

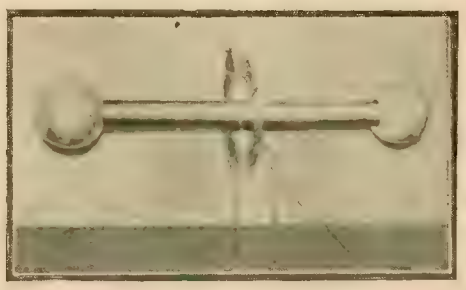
(*Continued from page* 960)

It is fairly easy with this method to knock electrons out of their normal positions in the atoms of any element used as a target. Comparatively low voltages suffice to give a stream of electrons or positively-charged atoms, used as projectiles, sufficient energy to accomplish this. But in order to penetrate the central massive structure of the atom, the nucleus, and disrupt it, the speed of these projectiles and consequently their hitting power must be increased enormously. This can be accomplished only by increasing the electrical pressure applied to the tube until it is of the order of several million volts.

Such voltages would give to the stream of electrons or atomic projectiles speed and energy comparable to the alpha-particles of radium which Sir Ernest Rutherford used in the pioneer attack upon the nucleus of the atom. Not only would the speeds and energies of radium particles be duplicated but the number of projectiles would be far greater than that obtained from any radium source. Even though the current through such a high voltage tube were no greater than that used in an ordinary X-ray tube, if the voltage were continuously applied to the tube as many high-speed particles would be produced as would emanate from several tons of radium.

### *Use of High Voltages*

The Department of Terrestrial Magnetism, of the Carnegie Institution, has undertaken this experimental work with the hope of extending the knowledge of the structure of



*A typical Tesla coil used in connection with the high voltage experiments is shown in the above photograph.*

matter which is the foundation upon which any fundamental understanding of magnetism must rest. Besides this, it is expected that by means of high voltages, radiations of the type which are at present supposed to be accountable for the observed phenomena of terrestrial electricity, can be produced on a small scale in the laboratory. Scientific investigations reveal that matter in all its forms is a constituent of different kinds of atoms which are grouped into molecules. All atoms have similar structures and are built up of separate unit particles of positive electricity called protons and of negative electricity called electrons.

According to the latest theories these fundamental particles are "wave packets" and matter consequently is wave motion. The behavior of the particles suggests that of ripples. Each atom has a central nucleus composed of protons and electrons but bearing a positive charge because the protons are in excess. About this nucleus additional electrons rotate in their orbits.

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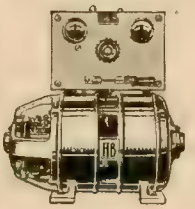

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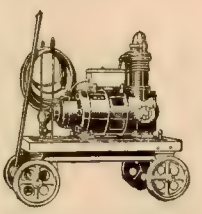

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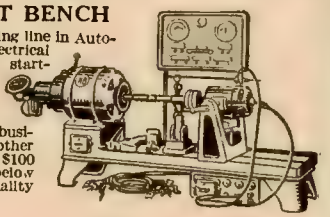

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## You Can Make Yourself Fit

You are not fit if you are weak, sickly and under-developed. You dare not marry and ruin some trusting girl's life if dissipation and excesses have sapped your vitality and left you a mere apology for a real man. Don't think you can save yourself with dope and drugs. They can never remove the cause of your weaknesses and will surely harm you. The only way you can be restored is through Nature's basic laws—as they are taught through STRONGFORTISM.

## Don't Be Despised---Let Me Make a He-Man of You

Don't stand by and see your body tottering and growing weaker and flabbier day by day, unfitting you for every physical function, making a sorry spectacle of you in everything you undertake. Don't do it—if you want to be a man—a real he-man—a man who will be noticed in a crowd by both men and women. Don't be a weakling when you can be a healthy, powerful, muscular fellow with a grip like iron, a chest that denotes strength, and a face that pictures buoyant health and happiness.

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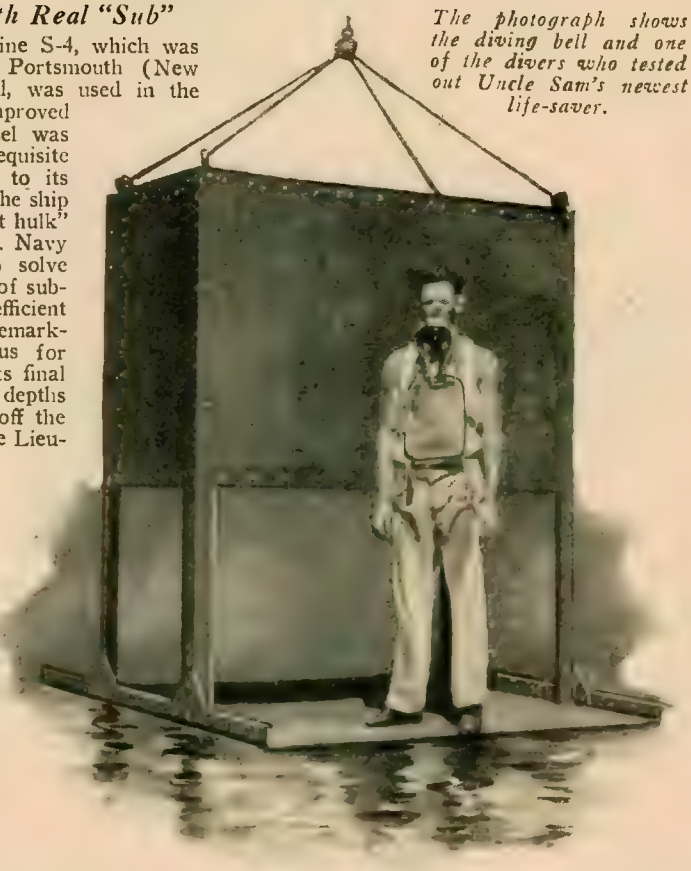
# Mechanical "Lungs"

By G. H. Dacy

(Continued from page 917)

### Experiments with Real "Sub"

THE salvaged submarine S-4, which was reconditioned at the Portsmouth (New Hampshire) Navy Yard, was used in the final tests with the improved subsea lung. This vessel was equipped with the prerequisite escape hatches attached to its various compartments. The ship is now known as the "test hulk" and will be used in U. S. Navy experiments designed to solve all the baffling mysteries of submarines and their most efficient operation . The *lung*, remarkable life-saving apparatus for submarine sailors, won its final "spurs" in tests made at depths of from 200 to 225 feet off the New England coast where Lieutenant Momsen, Chief Gunner C. O. Tibbals, one of the world's leading experts on the science of diving, and F. M. Hobsen, a U. S. Navy engineer, made successful ascents from the submerged S-4. This reconditioned "sub" is also being used in practical and scientific research involving tests of the strength and resistance of submarine bulkheads, doors and escape hatches. A multiplicity of experimentation with diving bells will also be consummated from this famous submarine. Many tests will be made to determine the most efficient methods of gaining access to the hull of a sunken submarine. Important research with lifting eyes for pontoons employed in raising disabled "subs" will be made. The magnetic telephone recently originated will be accorded a round robin of tryouts. It is an efficient transmitter of the human voice under water and promises to solve many stubborn problems of satisfactory communication with sunken submarines.



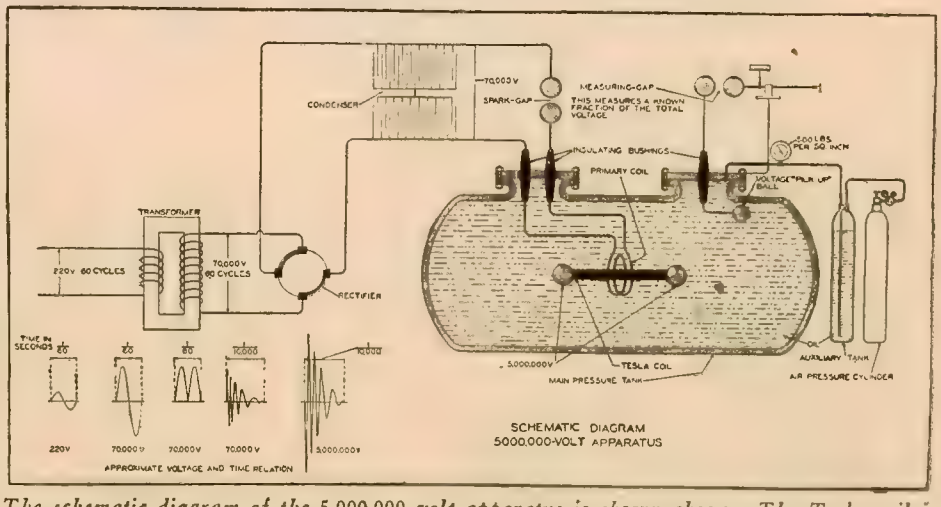
*The photograph shows the diving bell and one of the divers who tested out Uncle Sam's newest life-saver.*

# Shattering the Atom

(Continued from page 913)

### Breaking Up the Nucleus

If the charged particles of which an electric current is made up are released between two electrodes, to which a high voltage is applied, these particles will move at tremendous speeds due to the electrical attraction. If the particles are to attain maximum energy and velocity, they must be prevented from colliding with the atoms in the air in their travel, and electrodes are therefore placed in an evacuated tube.




*The schematic diagram of the 5,000,000 volt apparatus is shown above. The Tesla coil is placed in a tank filled with oil under pressure, in order to eliminate discharges at low voltages. The ordinary operating voltage of a coil of this type placed in air is at the maximum 300,000 to 400,000 volts.*



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# THE ORACLE

## Self-luminous Paint

(2294) F. Couchet, Frederick, Colo., writes:

Q. 1. What is the difference between luminous and self-luminous paints. Does ordinary luminous paint lose its properties?

A. 1. After the discovery of radium and the work done by Sir William Crooks with the spinthariscope, the phenomenon of radio active luminescence was observed. Following this a very minute quantity of radium salt was mixed with finely powdered zinc sulphide and combined with an adhesive for self-luminous paint. This is now used extensively on the hands and dials of watches and clocks, on the pointers of aircraft instruments, on electric switch buttons, and the like. Self-luminous paint which is radio-active is sometimes confused with the luminous paint often seen in stores. The base of this preparation is phosphorescent calcium sulphide, which requires the excitation of a strong light before it will shine. It absorbs the luminous radiation and emits it as a soft glow until it gradually fades away and has to be again excited to phosphorescence. Self-luminous radio-active paint differs entirely from the above preparation, for it contains its own exciting power and will continue to shine indefinitely even when kept in the darkness. According to recent research, the half period decay of radium is approximately 1,750 years. For example, if we have a gram of radium it will be reduced to one-half its weight in 1,750 years, leaving one-half gram. During the next period of 1,750 years, one-half of the remainder will disappear, leaving one-quarter of a gram, and so on. Thus, the life of the radium content of a self-luminous paint may be considered unlimited. With the zinc sulphide preparation, however, this is not the case. The quality of the sulphide itself is subject to variations in its purity and there is a certain amount of luminous quality in it which may be quickly liberated by strong excitation. The useful life of such a compound glowing brightly is much less than that which shows weaker luminescence. The intensity of the luminescence of self-luminuous paint depends upon the percentage of the radium salt mixed with the zinc sulphide.

The luminescent intensity given to a radio compound will depend upon the purpose for which it is used. The United States Government requires that self-luminous paint used in the Army and the Navy shall maintain an undiminished intensity of luminosity for two years. The phenomenon of radio activity is not confined to radium. A product of thorium, known as radio thorium, is radio-active, but it has a short life, its half period of existence being three or four years. Meso-thorium, from which radio-thorium is evolved, is now being used extensively in the preparation of self-luminous paints because of its cheapness.

## Headlight Tester

(2295) Carl Zombrowski, Fairchild, Wisc., asks:

Q. 1. Is there any method which has been tried for measuring the degree of glare from automobile headlamps?

A. 1. A device for determining the amount of glare from the headlamps of an approaching automobile has been developed by Dr. Dickinson, of the U. S. Bureau of Standards, and is described in the August issue of the S. A. E. Journal. By means of the instrument it is possible to determine whether the light from an approaching automobile exceeds a fixed light value. The device is simply a small portable photometer made from two pieces of oiled paper enclosed in a cardboard frame about 2 inches square. A small flashlight is trained upon them. The photometer is easily attached to the windshield and the apparatus is readily calibrated. A rheostat is used for varying the intensity of the standard light source. Readings can be obtained showing how the light of an oncoming automobile compares in intensity with the amount of light for which the photometer has been set. At the present time research work is being carried out by the Bureau of Standards, under the direction of the Society of Automotive Engineers, to ascertain what light distribution is best for night driving.

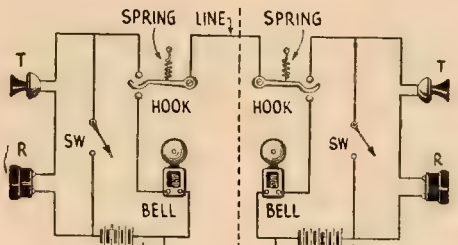
The "Oracle" is for the sole benefit of all scientific students. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink; no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 50 cents is made for each question. If the questions entail considerable research work or intricate calculations, a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

## Short Line Telephone

(2296) Paul H. Gathe, Vandalia, Ill., asks:

Q. 1. Will you publish a circuit diagram showing the connections for a short line telephone system using low resistance earphones?




*The above illustration shows the circuit diagram of a short line telephone which can be made with a few inexpensive parts. SW is a push button switch; T, the transmitting microphones, and R, ordinary 75 ohm receivers. A length of No. 14 wire is used as the line between the two telephone stations. Ordinary door bells can be used for the signal.*

A. 1. On this page you will find illustrated the diagram asked for. T is the transmitting microphone and R the receiver. Only one wire is needed between the two stations as the ground is used for one line. SW is a push button switch which rings the signal bell when closed. The receiver should be lifted from the hook when operating the push button switch for signalling. Ordinary door bells can be used for the signals.

## Eliminating Halation

(2297) D. Ferrarie, Maplewood, New Jersey, writes:

Q.1. Recently I have had occasion to take photographs of machinery, glassware and silverware. Considerable trouble was experienced in the reflection of light from the bright surfaces of the objects. Is there any way in which this can be eliminated easily?

A. 1. When photographing machinery the bright parts may be dulled by painting over with a thin coat of white lead and turpentine darkened with a little lamp black to impart a gray color. Frequently dabbing the surfaces with a lump of putty in a cheesecloth bag will effectively eliminate halation. Kerosene oil is sometimes used. When photographing brass statuary, rubbing with whiting will be useful. Rubbings obtained by placing a sheet of paper over the object and rubbing with a soft pencil or charcoal can also be employed. Hollow silverware may be filled with ice or cold water, so that the outer surface becomes bedewed.

The object can also be placed inside of tissue paper, so that the light reaching it must pass through the paper. Glassware may be treated in the same manner as the silver or the hollow vessels may be filled with some non-actinic solution. Coins can be smoked with magnesium ribbon, which leaves a delicate white film on their surfaces. In photographing objects under glass where it is desirable to show the glass, give about one-fourth of the time of the total exposure to the object with the glass in position; then remove the glass and complete the exposure.

## Protecting Balloons from Lightning

(2298) A. T. Dwyer, South Bend, Indiana, asks:

Q. 1. In general, what are the precautions which should be taken for the protection of captive balloons from lightning. How can the conductivity of the envelope be increased?

A. 1. The electro-static potential with reference to the earth increases with the height of the balloon. It is estimated as 50,000 volts at 1 km. altitude in fair weather. In stormy weather, thunder clouds may have potentials as high as 20,000,000 volts. The steel cable which holds the balloon will conduct an electric current from its upper end or point of higher potential to the end at the earth or point of low potential. The protecting devices in this case consist of conductors distributed over the surface of the balloon, to facilitate the transfer of the electro-static charge from the surface conducting it to the ground so that no differences in potential exist beween various parts of the rigging. It is not probable that during thunderstorms this method would be effective if the clouds carrying high potentials were moving rapidly toward the balloon. A report of the National Advisory Committee of Aeronautics recommends that the following precautions for protection from lightning be taken:

1—Good electrical connection between the earthed or grounded cable and the envelope.

2—Discharger system connected thereto.

3—Bonding of all projecting metal fittings and their connection to the ground.

4—Exclusion of moisture from the interior of the envelope.

5—Effective grounding of the balloon cable.

In the United States a small form of discharger is placed at the highest point of the envelope and is electrically connected to the metal valve and cable. The conductivity of the envelope may be increased by spraying the outer surface with thorium salt solutions or calcium chloride solution. This treatment, however, is not a permanent method of equalizing surface potentials because of the solubility of these salts in water. Powdered carbon or aluminum is better for this purpose. Strips of metallic tape have been tried but the objection to this method is the excessive weight.

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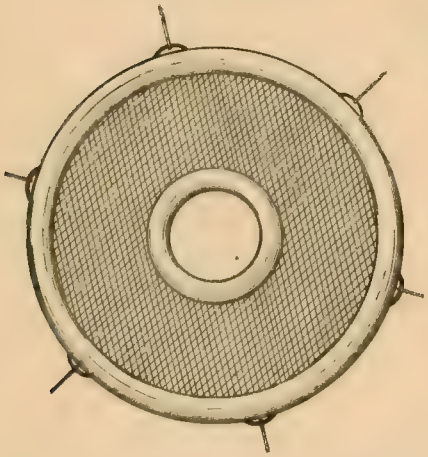
# LATEST PATENTS

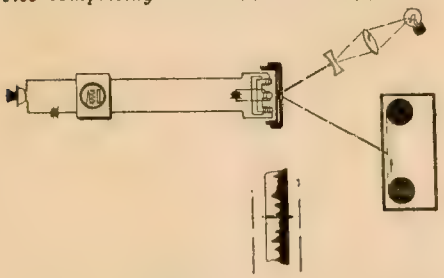
## Ice-Rescue Device



*No. 1,677,236, issued to Harriette Ensley-Hodgson. The above device comprises a portable open frame which can be bridged over the hole in the ice and affording a central manhole through which the person may escape. In order to increase the span, arms may be attached to the outer frame. The frame is provided at various points with cables, so that it may be held by rescuers at a distance. The mesh work is of wires and the rings are best made of aluminum tubing.*

## Sound Recording and Reproduction

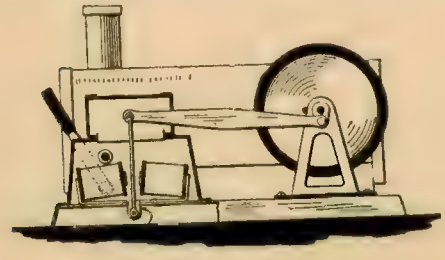
*No. 1,681,376, issued to Homer C. Snook. The system shown below is a telephonic device comprising a cathode and anode and a*



*means of producing a potential difference between the electrodes. Sound waves may be recorded permanently in an undistorted condition upon a film. The invention involves a distortionless amplifier and a photographic recording device. A variable beam of light falls upon a photo-electric cell as shown.*

## Toy Electric Engine

*No. 1,678,397, issued to Joseph Koenig. The mechanism below has a pair of electromagnets with an armature pivoted between them and projecting into the cylinder. A rod is connected to the upper end of the armature. After the switch is closed and the shaft rotates, a pin automatically makes and breaks contact supplying first one and then the other magnet with current which imparts a reciprocatory motion to the connecting rod.*



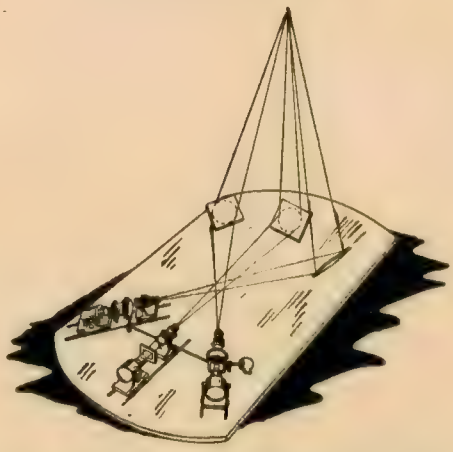
**Notice to Readers:**

**These illustrated and described devices have recently been issued patent protection but are not as yet, to our knowledge, available on the market. We regret to advise that it is impossible to supply the names and addresses of inventors of the devices to any of our readers. The only records available, and they are at the Patent Office at Washington, D. C., give only the addresses of the inventors at the time of application for a patent. Many months have elapsed since that time, and those records are necessarily inaccurate. Therefore, kindly do not request such information, as it is practically impossible to obtain up-to-date addresses.**

## Valve Leak Detector

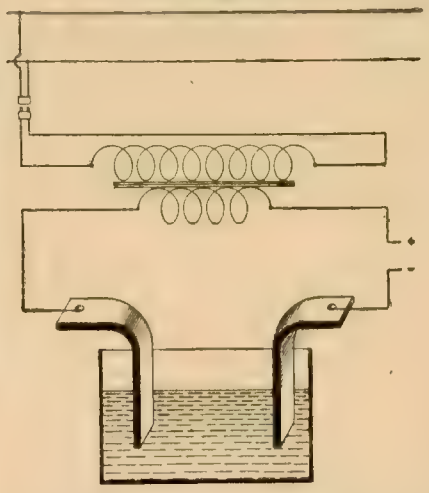
*No. 1,682,095, issued to Engracio P. Offemaria. The valve leak detector shown here can be used for indicating the presence of a leak in a tire valve or tube. A liquid having a phosphorescent characteristic is contained in a transparent receptacle into which the air from the leak passes, thereby enabling the user to see the bubbles even in the dark. The bottom end is flared outwardly to catch air escaping from a punctured inner tube. A pipe within the transparent cylinder provides for the escape of the air.*

## Optical Sign Projector



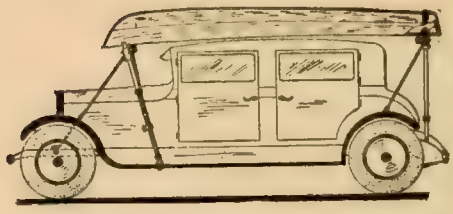
*No. 1,682,163, issued to Wm. Arthur Alder. This device is to be used as an advertising medium and comprises three projectors. Reflectors cause the beams to meet at a common point. Color filters are arranged to rotate in front of each projector. Signs or words so projected are visible to the observer without the employment of a background.*

## Rectifier Electrode



*No. 1,686,316, issued to Edgar W. Engle. This invention relates to improvements in rectifier electrodes and provides a non-film forming electrode which will not disintegrate. Rhodium is not appreciably decomposed by a rectifier electrolyte. The film forming electrode is preferably a tantalum strip. Both the pure metal and alloys of rhodium can be used. The strips of the two metals are bent as shown.*

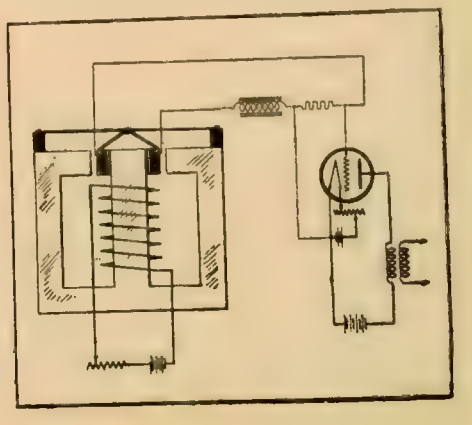
## Boat Carrier



*No. 1,681,936, issued to Golden A. Hillstrom. The device shown provides a quickly attached boat support to be used on automobiles. A pair of inverted U shaped risers are mounted on the car and support the boat in an inverted position. To stiffen the main portion of the structure, inclined braces are provided. The boat may be carried with its prow either toward the rear or the front of the automobile.*

## Dynamic Transmitter

*No. 1,680,399, issued to Phillips Thomas. This invention causes the wave form of the diaphragm vibration to be translated into voltage variations without distortion and has a moving coil type microphone, which comprises a magnet member of E shape. The circuit diagram is shown.*



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# Scientific Humor

### BUSINESS EXPANSION

JONES: "Do you always advise your neurasthenic patients to have a constant companion."

DOCTOR: "Always. The companion subsequently becomes another neurasthenic patient."—*Wilbur Alexander.*

### REAL "CLEAR" SOUP

"My plate is damp," complained a traveler in a London hotel.

"Hush," whispered his wife, "that's your soup."—*Dollard Hanlon.*

### DEVASTATING BREATH

Said the bibulous gentleman who had been reading birth and death statistics:

"Do you know, James, every time I breathe, a man dies?"

"Then," said James, "why don't you chew cloves?"
—*John Novick.*

### A BEE WRENCH MIGHT HELP

ZOOLOGY TEACHER (to pupil who had brushed off a bee that stung him): "Ah, you should not have done that, the bee will die now. You ought to have helped her extract her sting, which is spirally barbed, by gently turning her round and round."

PUPIL: "All very well for you, but how do I know which way she unscrews?"
—*Earle Bennett.*

### JUST A DRIFTER

SCIENCE TEACHER: "Where did Noah live?"

BRIGHT BOY: "He was a member of the Floating Population."—*Leslie F. Carpenter.*

### SELF-INDICATING RADIO

First Prize—$3.00

DING: "What kind of a radio have you got?"

DONG: "The railroad type—whistles at every station."—*Earle Bennett.*

### THROUGH HILL AND DALE

"Terribly rough," said the stranger on board the ocean liner.

"Well," said the farmer, it wouldn't be near so rough if the captain would only keep in the furrows."—*Wilbur Alexander.*

*ALL jokes published here are paid for at a rate of $1.00 each; $3.00 is paid for the best joke submitted each month.*

*Jokes must have a scientific strain and should be original.*

*Write each joke on a separate sheet of paper and add your name and address to each.*

*Unavailable material cannot be returned.*

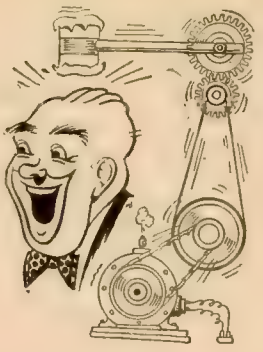
### IT AUTO DO

"Every time a farmer used his auto, he put "Bran" in the radiator to stop the leaks. When he came home he had "cooked feed" for his hogs."—*Deibert Iacey.*

### HOW DOES SHE KEEP COOL

BRIGGS: "Is your stenographer a fast worker?"

WIGGS: "She's so fast that she has to use a water-cooled typewriter with an asbestos ribbon."—*Earle Bennett.*



### YEAST SUPERFLUOUS

CHEMISTRY PROFESSOR: "Now, Mr. Jones, what do you know about Boyle's law?"

DUMB JONES: "Nothing, I never had any boils."—*Donald Little.*

### S'TEW BAD

YOUNG BRIDE: "Now, dearie, what will I get if I cook a dinner like that for you every day this year?"

ANSWER: "My life insurance."
—*Frederick Birch.*

### THE OILY BIRD

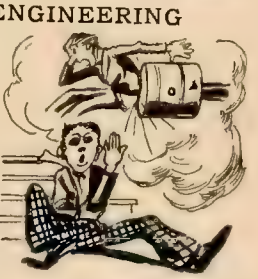
"Even in the Biblical times it was customary to anoint the head with oil, but not by crawling under an automobile."
—*Leslie Davis.*

### MEN—GET BUSY

"Is it true that statistics prove women live longer than men?"

"Well, you know paint is a great preservative."—*Miss Mary Sanday.*

### MOTOR ENGINEERING



INTAKE: "When Dorothy opened the door, and admitted me to the parlor.

COMPRESSION: "When I gently took her in my arms and—

POWER: gave her my sweetest kiss."

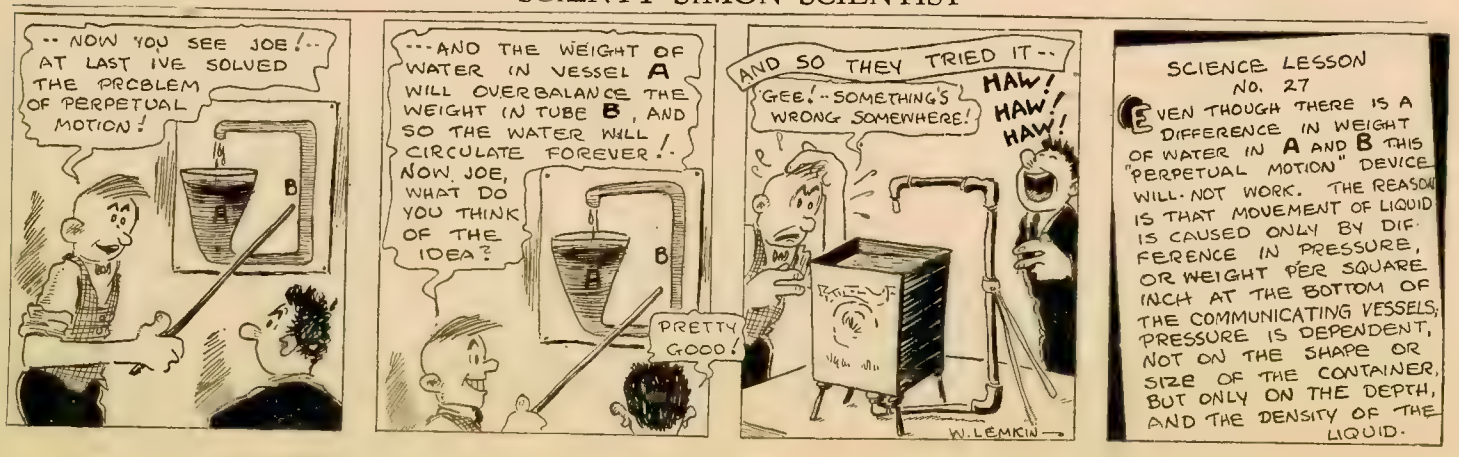
EXHAUST: "When the toe of Dorothy's daddy's boot boosted me down the porch steps."—*J. Leo Vanderheyden.*

### THE LUCK CHARM

"Don't you know," said Mr. Johnson, "that you can't sell life insurance without a license?"

"Boss," said the darky, "I knowed I couldn't sell it, but ah didn't know the reason."—*Edward Piranian.*

## SCIENTY SIMON SCIENTIST


-- NOW YOU SEE JOE!-- AT LAST IVE SOLVED THE PROBLEM OF PERPETUAL MOTION!
A
B
---AND THE WEIGHT OF WATER IN VESSEL A WILL OVERBALANCE THE WEIGHT IN TUBE B, AND SO THE WATER WILL CIRCULATE FOREVER!. NOW, JOE, WHAT DO YOU THINK OF THE IDEA?
PRETTY GOOD!
AND SO THEY TRIED IT --
GEE! -- SOMETHING'S WRONG SOMEWHERE!
HAW! HAW! HAW!
W. LEMKIN

SCIENCE LESSON
NO. 27

EVEN THOUGH THERE IS A DIFFERENCE IN WEIGHT OF WATER IN A AND B THIS "PERPETUAL MOTION" DEVICE WILL NOT WORK. THE REASON IS THAT MOVEMENT OF LIQUID IS CAUSED ONLY BY DIFFERENCE IN PRESSURE, OR WEIGHT PER SQUARE INCH AT THE BOTTOM OF THE COMMUNICATING VESSELS; PRESSURE IS DEPENDENT, NOT ON THE SHAPE OR SIZE OF THE CONTAINER, BUT ONLY ON THE DEPTH, AND THE DENSITY OF THE LIQUID.

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# RADIO ORACLE

## 30-Henry Choke

(664) James Clarke, Westfield, Mass., writes:

Q. 1. Will you please supply me with information about the construction of a "B" eliminator choke which has an inductance of about 30 henries while handling a current of approximately 85 milliamperes.

A. 1. The core of the choke coil should be made from silicon steel laminations, the thickness of each lamination approximately corresponding to Brown and Sharp gauge No. 26. The core is a single magnetic circuit with a square cross-section, 1¼" x 1¼". The core is built up from laminations of four different sizes, 78 of each size being required if the laminations are gauge No 26. The largest laminations are 5¾" long by 1¼" wide, the next 4" long, the next are 2⅜" long, and the smallest laminations are 1⅛" high by 2¾" wide. The core has four butt joints, a piece of ordinary writing paper is inserted at each of the joints to provide the necessary air gap.

The coil should have about 7,800 turns of No. 26 enameled wire, wound with 150 turns per layer. This coil should be wound on a wooden form, then bound with tape and slipped over the core leg which is built up with the 5¾" laminations. The direct current resistance of this choke will be about 240 ohms.

## Television Standard

(665) Robert Knowles, Alameda, Calif., writes:

Q. 1. At the present time has any standard been agreed upon for the number of pictures per second and number of holes in discs used for television broadcasting?

A. 1. The Radio Mfrs. Assoc. has decided that as a standard, the system used by C. F. Jenkins will be employed. This station uses 48 lines arranged so that they follow each other from top to bottom with the picture scanned from left to right. Fifteen separate frames are transmitted every second.

## Battery Life

(666) H. B. Wentworth, Trenton, Tenn., asks:

Q. 1. Can you supply me with a service curve showing the service hours at various currents obtained with a medium sized 45-volt "B" battery.

A. 1. On this page you will find the curve requested which shows the service record of a 45-volt "B" battery known commercially as a 5 lb. battery. The results shown were determined by one of the large battery manufacturers in a series of laboratory tests. This gives the service hour capacity at various currents to an end voltage of 34 volts with the discharge based on an intermittent service of 2 hours per day. The current from a "B" battery to a tube does not remain constant but drops off as the battery voltage decreases. To estimate the service hours of batteries, it is necessary to know the average working voltage of these batteries. The average working voltage of a 45-volt battery between 45 volts and an end voltage of 34 volts is 39.5 volts.

## Screen Grid Hi-Q

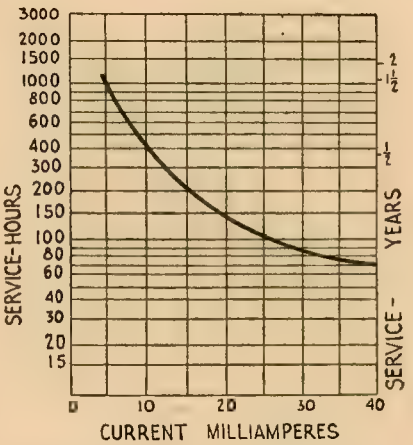
(667) R. Henly, Niagara Falls, New York, asks:

Q. 1. I would appreciate your giving me some information concerning the radio frequency stages used in a Hi-Q circuit. I understand that a transformer of new design having a one to one ratio is employed with the shielded grid tubes. If possible, kindly publish a circuit diagram showing one of the radio frequency stages.

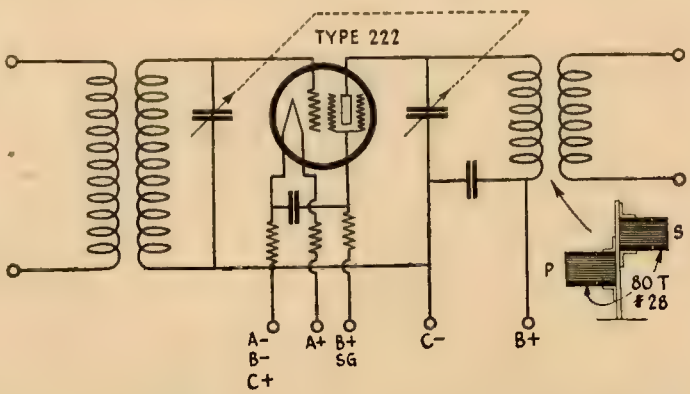
**While there are many topics of interest to the radio enthusiast, which could be covered on this page, the editor finds it necessary to devote this space to items of timely interest.**

A. 1. On this page you will find a circuit diagram of a radio frequency stage such as used in the Hi-Q. A specially constructed radio frequency coil is used and is illustrated here also. The primary and secondary both have the same number of turns, namely, 80. The detector input coil has a tap at about the 20th turn from the grid end to which the grid of the detector tube is connected. Each of these similar coils is tuned with a variable condenser. When both the plate and grid circuits are in resonance, the maximum secondary voltage is obtained with a low coupling co-efficient. The loosely coupled tuned circuits really constitute a band-pass filter. When both circuits are properly coupled the response curve is about 8 kilocycles wide and slopes steeply on each side and the response approaches zero much more rapidly above and below the resonant frequency. The flat portion and width of the top of a response curve will influence the quality of the received signal. A receiver should be capable of passing and amplifying a band of frequencies if the program is to be reproduced faithfully. Broadcasting stations transmit on a band of frequencies with the width of side bands varying to a certain extent.

The tuned R.F. transformers of the Hi-Q type need four variable condensers but, since all the tuned circuits are identical, the condensers can be used with a common shaft. The antenna coupler is tuned with a separate condenser.




*The above graph shows the service hours which may be expected from a good "B" battery for any given current drain.*




*Above is the schematic diagram of a typical shielded grid stage of radio frequency, such as is used in the Hammerlund Hi-Q 1929 model receiver. The radio frequency transformer is also shown and consists of two identical coils, both having the same number of turns. The circuit is, in fact, a band-pass filter arrangement.*

## Reducing Antenna Effect of Eliminator

(668) A. Rampelli, San Francisco, Calif., writes:

Q. 1. Is there any method which can be used for reducing the antenna effect of a "B" eliminator?

A. 1. A fixed condenser placed in series with the ground will prove effective. In some cases it may even be necessary to reduce the length of the regular aerial or disconnect it entirely. The provision of a counterpoise may sometimes be necessary. Disconnect the regular aerial and ground and connect the counterpoise to the ground binding post. This will give a slight condenser effect between the lighting circuit and counterpoise, thereby increasing the selectivity. Sometimes it will simply be necessary to move the eliminator away from the receiver as the signal may be transferred by induction. Sometimes it will be helpful to provide a radio frequency choke coil in series with each output line of the eliminator with by-pass condensers placed between each output terminal and the B negative. This will isolate the R.F. currents and prevent them from getting into the plate circuits of the tubes.

## Push-Pull

(669) B. C. Koller, Toronto, Ont., Canada, writes:

Q. 1. How can I arrange my push-pull stage so that the 210 power tubes will show the same plate current reading?

A. 1. The amplifier tubes may be brought to operate at the same plate current by lighting them from separate filament transformer windings. Each winding should be provided with a center tap or a center tap resistor and two grid biasing resistors will be required instead of one. One end of each grid biasing resistor is connected to the center tap of the transformer filament winding. The other end of each grid bias resistor is connected to the B—. The center tap of the push-pull input transformer is also connected to the B— lead. Resistors of about 1,900 ohms each should be used when employing 210 tubes. With this arrangement, if one tube does not function properly, the second tube will not be overloaded.

Q. 2. Is it possible to control the first audio stage, so as to cut down the hum.

A. 2. A high resistance potentiometer having a resistance of 500,000 ohms, if connected across the secondary winding of the first audio transformer, with the grid of the tube connected to the movable arm, will provide a means for controlling the strength of signal and hum fed from the detector and the first audio tube.

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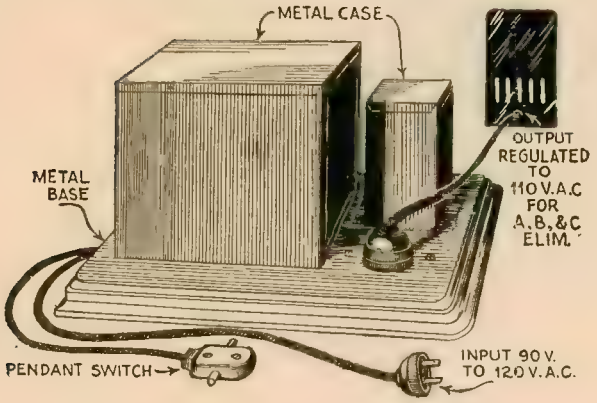
# New Radio Devices

## Voltage Regulator



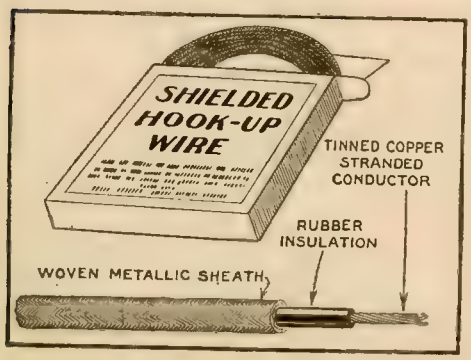

*Above is the line voltage regulator which can be installed in a few minutes. This device keeps the output regulated to 110 volts even though the input may vary from 90 to 120 volts. A black metal case encloses the regulator.*

THE life of the new A.C. tube is materially shortened if the filament is operated at voltages in excess of the normal value. To meet this difficulty, a Chicago manufacturer is now making a constant voltage regulator, the output of which remains at 110 volts despite any variations in line voltage. Aside from lengthening the life of the tubes, the device also prevents volume changes due to fluctuations in the supply voltage. When a voltage lower than that specified is applied to an A.C. tube filament, the amplification factor falls off. It is evident, therefore, that for efficient A.C. operation, a device of this nature can be used to advantage. It must not, however, be confused with the line voltage reducer which merely brings the voltage within a safe value but does not compensate for fluctuations.

Line voltage reducers simply consist of a fixed or variable resistor placed in series with the A.C. line. The regulator shown here is housed in a metal case and contains no moving parts, liquids of any kind, ballast resistor or tubes. Installation can be made easily. The plug from the regulator is inserted in the light socket and the plug from the eliminator inserted in the receptacle on the regulator. A pendant switch is provided for turning the voltage supply on and off.

## Shielded Hook-Up Wire

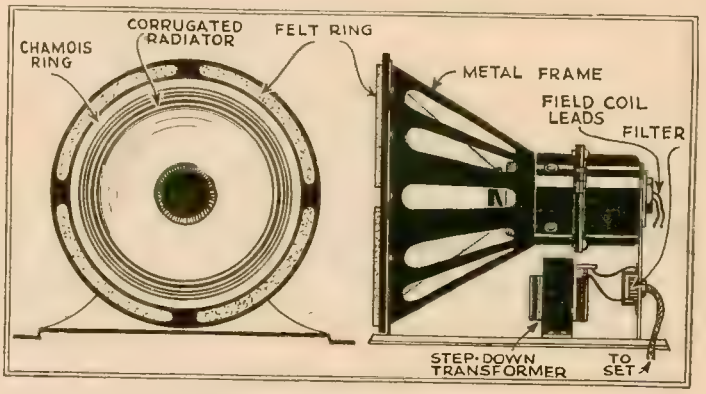
THE use of the shielded grid tube in radio receivers is increasing rapidly. A progressive radio concern in Chicago has made shielded hook-up wire available to home constructors. It is a well-known fact that the grid and plate leads from the 222 tubes should be shielded for proper results and this wire has been made with this view in mind. Of course, it can also be used for the grid and plate connections with regular vacuum tubes as well as with the shielded grid tube. A flexible woven metallic sheath covers the rubber insulated stranded wire, permitting it to be bent in any desired position. The sheath on the wire should be grounded.




*The shielded hook-up wire is shown in the illustration at the left. The tinned stranded copper conductor is first covered with a rubber insulation, and then with a woven metallic sheath which renders it admirably suited for use with shielded grid tubes.*

## Dynamic Reproducer Unit

AMONG the few really good dynamic speakers which have come to the attention of this department is one made by a California radio company and is illustrated here. A D.C. model is shown, although the manufacturer provides A.C. types and also complete speakers in cabinets or consoles. No rectifier is provided as the field winding is excited with a direct current of 40 to 80 milliamperes at 75 to 150 volts. The field coil is therefore wound to a high resistance, 1,900 ohms, to enable its excitation from a power pack. With suitable filter, it can also be used from the direct current line. A filter is provided which cuts off any frequencies above 5,000 cycles, so that disturbing effects and tube noises in the set and amplifier are not reproduced. Unlike magnetic speakers, its response is good and free from resonance peaks. The radiator or cone has been partly corrugated to allow maximum excursion. A chamois ring supports the cone about its periphery.

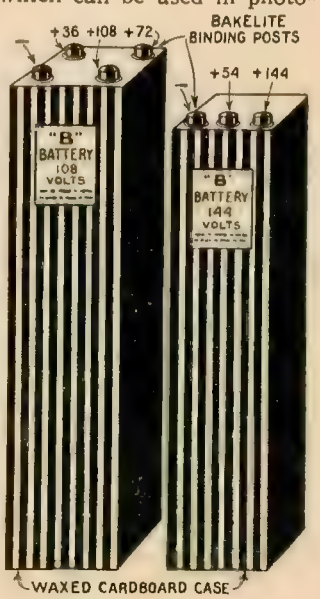



*The electro-dynamic speaker described in the text is shown above. All important features have been shown. The field winding is excited with a direct current of 40 to 80 mils at 75 to 150 volts.*

## High Voltage "B" Battery

A WELL-KNOWN battery manufacturer is now producing a high voltage "B" battery which can be used in photo-electric cell and neon tube experiments. They will soon be made available to the trade as part of the television equipment. Two types are made at the present time, one delivering 108 volts and the other 144 volts. The nominal initial amperage in both batteries is 5 amperes. In their construction cylindrical cells are soldered together in tubes which give them a rigidity not possible with other types of construction. All parts used in the assembly are of insulating materials and thoroughly impregnated. A waxed cardboard case furnishes a waterproof covering. Taps are provided so that a choice of voltages are obtainable. The larger type of battery is 15 in. high, 3⅜ in. wide, and 2⅝ in. deep; the other is 13¼ in. high and 3 in. square.

In emergency these batteries may be disassembled by chipping off the top seal and slicing off the paper bottom. This exposes the ends of the tubes of the cells which can then be tested with a voltmeter, thereby determining if they are still good.




*Two types of the new high voltage "B" battery have been illustrated above. Both are enclosed in waterproof cases. As will be seen, these batteries are long and narrow, thereby lending themselves to easier installation.*

*Names of manufacturers supplied upon request.*

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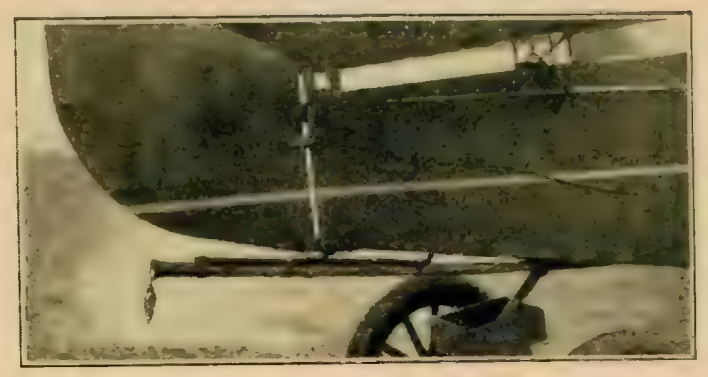
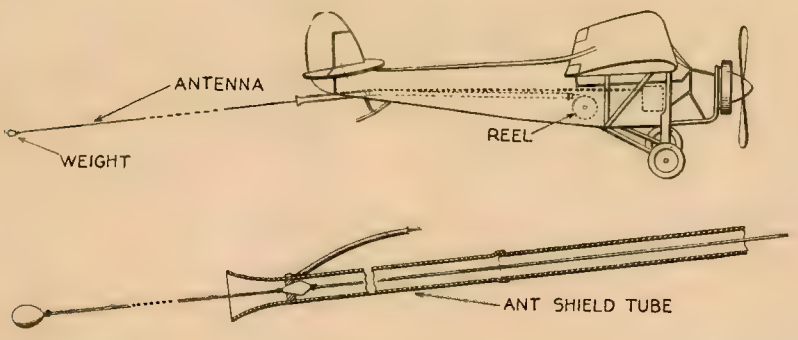
# Height of Airplane Determined by Reflected Wave

in a plane during test. Observations were also made with a barometric altitude meter as well as the radio altitude meter and logs of the flight constructed as shown. The radio echo enables the measurement of the height above the ground, while the barometric log only gives altitude over the starting point.

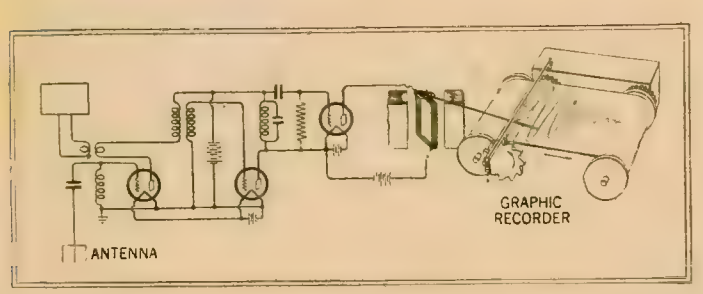
As an example, let us suppose an aviator wishes to reset his barometric altitude meter for the actual level of the ground. He will put the graphic radio altitude meter in operation and proceed to climb. The amplitude of the wavy line will give an indication of the height above the ground. If a more accurate determination is wanted, let us assume that he can change the wavelength of the instrument about eight per cent by pressing a key. By periodically pressing the key, two graphic curves can then be traced one, let us say, for 100 meters and the other for the wavelength of 92 meters. The phase relation of the two curves will be shown on the graphic record. If they are in phase, then the distance travelled by the returning or echo wave may be measured in whole wavelengths for the two transmitted wave frequencies. Thus, the 100 meter wave may have travelled 12 wavelengths and the 92 meter wave 13 wavelengths. In this case, therefore, the distance above the ground would be 600 meters or 2000 ft. If the variations of the two records are 180 degrees out of phase, it can be concluded that the altitude is either 300 meters or 900 meters. However, the amplitude of the echo will indicate which of the two indications is correct. The barometric instrument can thus be definitely calibrated with reference to the ground.



*The antenna shield tube attached to the back portion of an airplane is shown above. The length of the antenna can be regulated by the operator or the navigator.*




*The antenna shield tube extends from the rear of the plane to the cockpit. The antenna wire is wound on a reel enabling its length to be varied. A sectional view of the antenna shield tube showing position of wire and weight also appears.*




*The circuit diagram of the radio echo receiver is reproduced here. The graphic recording device is connected to the output as shown. This principle will be applied for practical aerial navigation and continuous graphic records will make it possible to identify the course flown with maps and previous experience. Such logs may also be used for surveying.*

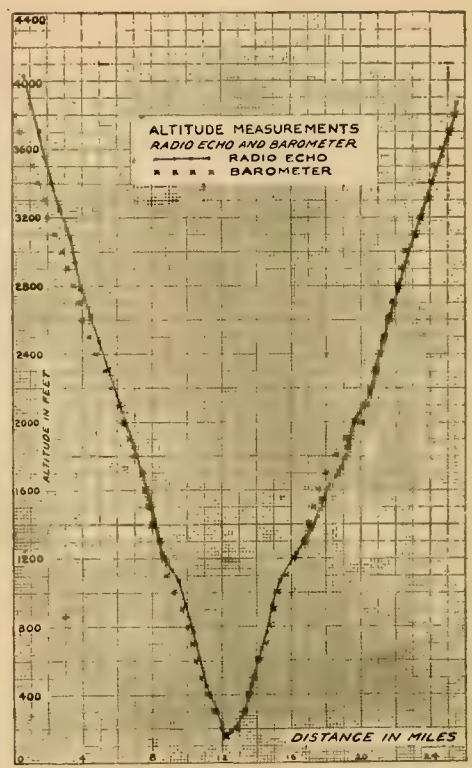
### *Another Method*

IT has also been suggested that two antennas with an oscillator in each be used. One antenna may have a wavelength of 10 meters and the other 11 meters, so that the beat frequency between the two may be detected and observed. The maxima of the beat frequency will occur at heights of 80 ft., (25 meters), 240 ft., (125 meters), etc. Such a scale of indications may be a guide for landing in fog or at night. If the oscillators are set at an interval of 2 per cent between them, then a maxima scale is obtained with steps five times as large as those obtained with a 10 per cent interval between the oscillators. At 400 ft. (125 meters) the strongest maxima will occur and these two scales may be used in succession. It is also possible to have green and red indicating lights glow at 1200 and 400 ft. for the approach, and at 240 and 80 feet for the final landing glide. A third scale may then be established by measuring the radio frequency of the antenna oscillators which will pass through maxima at 45 and 15 feet.

### *Landing in Fog*

IT is expected that other radio indications will be established to determine the position of the landing fields. Such signals may be received by the same radio set as the altitude indications and may be brought to the aviator's attention by oral or visual indicators without interfering with the operation of the radio altimeter. If these radio indications of height and position are combined with a landing device of a mechanical nature touching the ground at about 15 feet, it is feasible in the opinion of aviators that safe landings may be made in fog without any vision of the landing field. These devices, together with neon beacons and radio beacons, add greatly to the safety factor in flying.

So accurate is the radio altimeter that in the tests, Dr. Alexanderson, blindfolded, and using headphones determined the exact altitude above the ground up to 1600 ft. by counting cycles of tone. Every time the airplane changed altitude by half a wavelength, the whistling note of the signal went through a complete tone cycle from a low pitch to a high pitch and then back to a low pitch.




*Observations made with the radio altitude meter and a barometric altitude meter are shown in the above graph. Thus, observations by two independent means are obtained by the aviator. Altitudes up to 4000 ft. are shown. The barometric log gives altitude over the starting point, and the radio log gives actual altitudes over the ground.*

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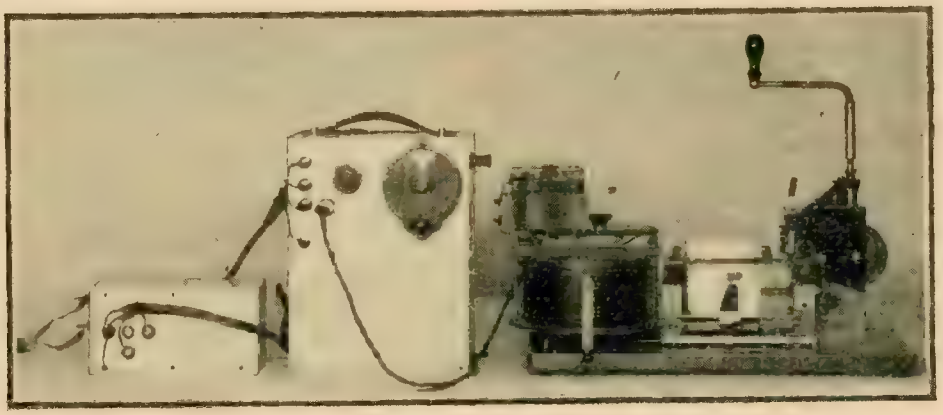
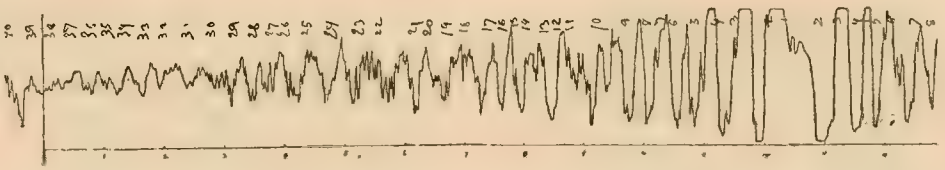
# RADIO DEPARTMENT

## The Radio Altimeter

TIME and time again radio communication has come to the aid of the aerial navigator and proven its inestimable value. Again radio has helped the aviator to keep on his course by means of the radio beacons now employed. The most recent use of these invisible waves has been in the development of what may be termed a "radio altimeter" designed by Dr. E. F. W. Alexanderson and his associates, at the General Electric Co., in Schenectady, New York. Distance measurements have been made by sound waves and it is simply necessary to measure the time for the return of the reflected wave. However, with radio waves travelling at a speed of 186,000 miles per second, the time interval becomes extremely short and necessitates the use of other means of measurement for the return of the reflected wave.



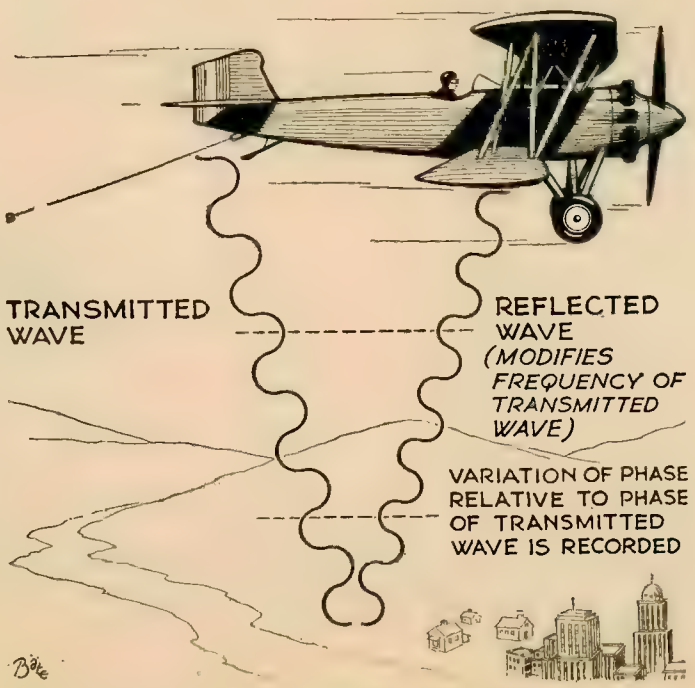
*The above photograph shows the equipment used on the plane for ascertaining the altitude. Graphic records are made with the device shown on the right hand side of the photograph while the receiver is at the left housed in a metal case.*



*A graphic record of the frequency variations is shown above. The radio altimeter measures the distance which the reflected wave has traveled. This can be accomplished in two ways, by measuring the strength of the returned wave or by the number of cyclic changes in phase which this wave has passed through.*

### *Measuring the Time*

THE time interval can be measured in units equal to the time of one cycle of the antenna current and the time interval of the echo or reflected wave is then equal to the number of wavelengths which the reflected wave has traveled from the antenna to the ground and back again. Now if this distance is changed or varied by an amount equal to a fraction of a wavelength, then this variation will manifest itself in a corresponding variation of the phase of the reflected wave relative to the phase of the original or transmitted wave. If the distance is varied by an amount equal to several wavelengths, then the phase in the returning wave will go through a corresponding number of cyclic changes of phase. If means are provided for determining the phase of the reflected wave, then the number of cyclic changes can be counted and it is thereby possible to make measurements of the height above the ground. Thus, we see that the phase of the returning wave or echo, in relation to the transmitted wave must be determined but a direct measurement of phase is difficult. It was found during the tests, that the reflected wave modifies frequency of the original wave and that this change is dependent upon the strength as well as the phase of the reflected wave. These changes in frequency are used to detect the phase of the reflected wave. It had been assumed that the reflected wave would only modify the phase but not the frequency of the original waves or oscillations. Practical tests were made and it was found that an oscillator was acted upon by external forces. Thus, if the force coming from the outside is in phase with the restoring forces (those forces which are contained in the oscillator itself), the oscillator will swing to a higher frequency, but if the force on the outside is out of phase, the oscillator will change to a lower frequency. This is true in both mechanical and electrical oscillators.


TRANSMITTED WAVE
REFLECTED WAVE (MODIFIES FREQUENCY OF TRANSMITTED WAVE)
VARIATION OF PHASE RELATIVE TO PHASE OF TRANSMITTED WAVE IS RECORDED

*This illustration shows the principle upon which the altimeter works. A signal is sent out from the plane and the reflected wave is picked up.*

### *Radio Altitude Meter*

WHEN it was learned that the change of phase of the reflected wave caused a corresponding change in the frequency of the antenna oscillator, a basis had been established for a radio altitude meter. The distance which the reflected wave has traveled before returning to the antenna can be measured in two ways; either by the strength of the returning wave which determines the frequency change or by the number of cyclic changes in phase which the wave has passed through before returning to the plane.

### *Graphic Record*

MEASUREMENTS are made with an instrument that traced a graphic record of the frequency variations. One of these records is shown here and was made

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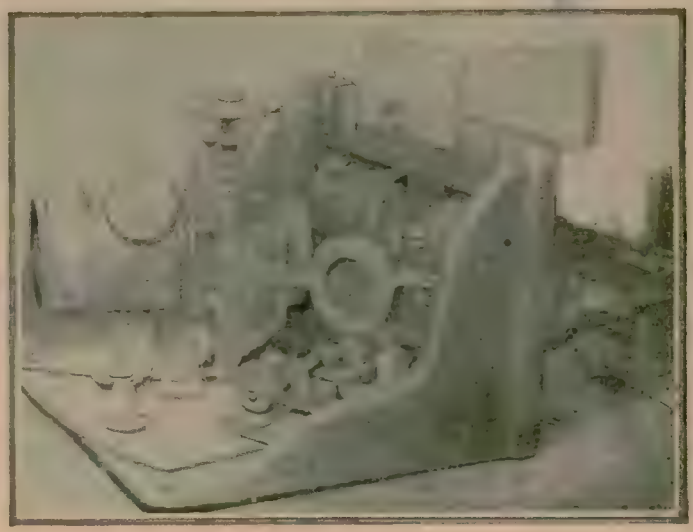


*The photograph above and that at the right show the apparatus as used with an arc lamp. A lens focuses the rays from the lamp so that they converge upon the mirror which reflects them.*

ing. Even when made of gelatine, on which a fine grating pattern is photographed, its mass is many thousand-fold that of an oscillating mirror which has an area of 1-1,000th of a square inch and which weighs 1-1,000,000th pound—about as much as a small grain of white sand. Such a grating may be oscillated at television speeds by attaching it to the moving coil of a dynamic speaker element by energizing the coil with upwards of 50 watts. Such power is, of course, beyond the limitations of a home-receiver; and, consequently, the valve having a grid which must be oscillated is impracticable for general adoption.

Still another valve comprises an oscillograph or oscillator which throttles a single filamentary ray of light a few hundredths of an inch thick; the speed and accuracy of this device is satisfactory, but the almost negligible quantity of light which is controlled is inadequate except for small pictures.

### *Multiple Beam Method*

A PROMISING method, shown in the accompanying views, consists in simultaneously valving *several hundred thin beams* by means of reflection from (*Continued on page* 998)

# Television in the Schools

*Television is now recognized as a rapidly developing science which is the outgrowth of radio. Many schools have been established or have taken on an extra curriculum for teaching radio. Now the theory and building of television receivers is also being taught at the Lane Technical High School of Chicago.*

*This school is one of the pioneers in teaching the theory of radio, as well as television. The above photograph shows an instructor supervising a group of students for constructing television receivers in the school laboratory. Several scanning discs may be seen, as well as a completed scanning unit at the left.*

# Television Light Modulator

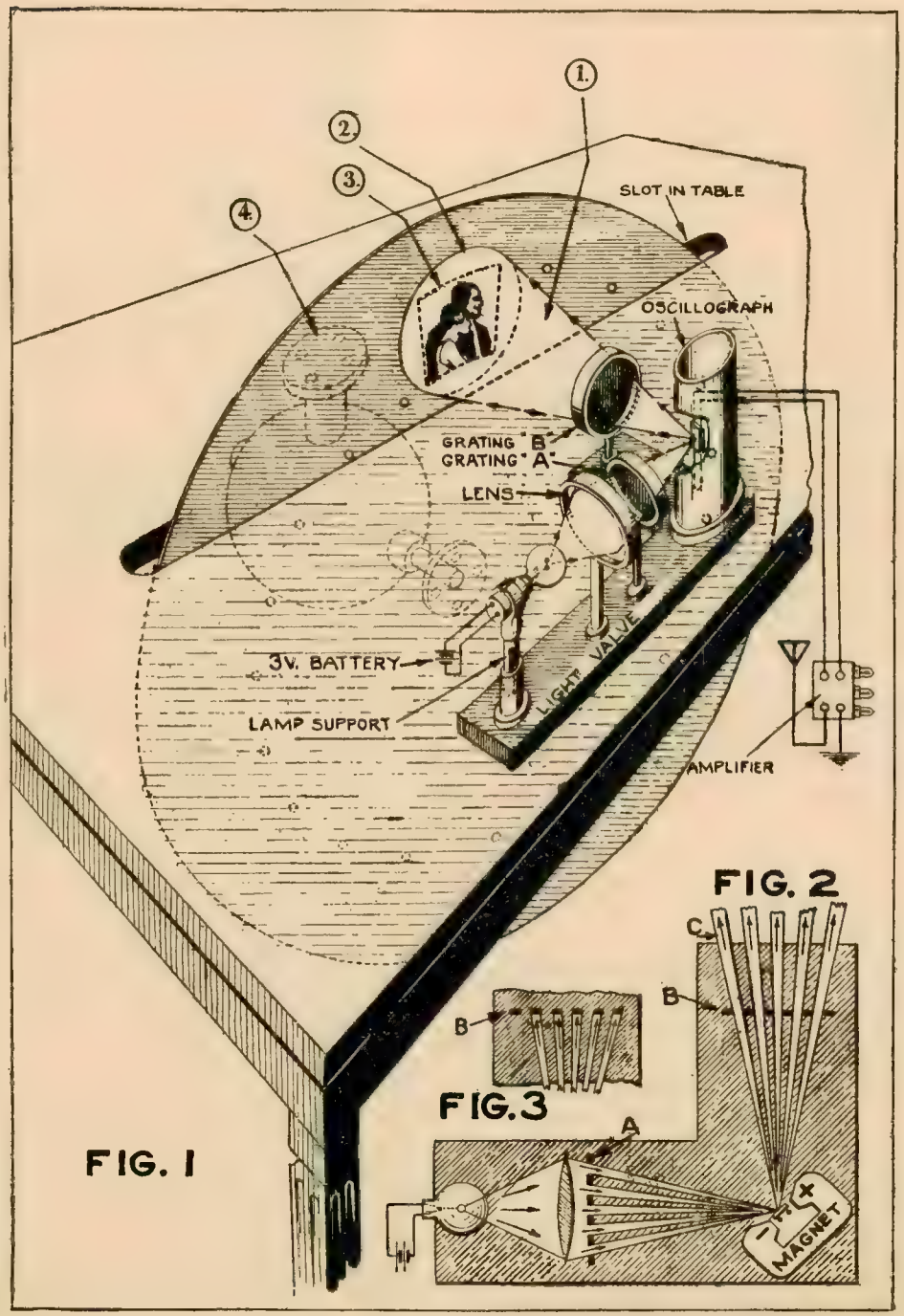
*By* PAUL L. CLARK

THE intensity of the light flashes illuminating a television scanning disk must, for sharply delineated pictures, be varied instantly. The minimum frequency for creditable picture signals is about 40,000 per second; so that each photoelectric signal derived from a small point-like area of the subject at the distant broadcast station and instantaneously impressed upon the scanning disk of the television receiver be simultaneously translated into a flash of light which has an intensity and persistency corresponding to that of the broadcast signal.

### *Existing Methods*

SEVERAL devices have been used, with varying degrees of success, for grading the brilliancy of the rays which produce the television image upon the scanning disk of the receiver. The modulator now being used by many experimenters is the two-electrode glow lamp, filled with neon gas. The characteristics of this lamp are such as to render it particularly adaptable for high-speed light variations, which are a requisite for receiving clear images on the receiving screen or scanning disk. A second device comprises a flash-light bulb having a fine filament connected to the output of a regulation radio receiver; the frequency of response of such a lamp is, however, insufficient for television work, as the time required for alternately heating the filament to incandescence and cooling it is of too great duration. A third method consists in passing a beam of polarized light between the two plates of a condenser connected to the receiving set. The latter system is rather elaborate, but produces a sizable beam of good brilliancy which is instantaneous in response to the radio signals. Another valve consists of a pair of gratings each having many fine lines and transparent spaces, one grating being set rigidly and the other vibrated across the fixed grating so as to intercept the rays proportional to the registration of the bars and spaces, the vibratory motion being secured by attaching the moving grating to the diaphragm of a telephone, the disadvantage of the latter system residing in the fact that high-frequencies through suitable amplitudes are unobtainable by virtue of the inertia of the relatively heavy moving grat-

(*Continued on opposite page*)




*The above illustration shows the connections and apparatus used with the light beam modulator for television reception. The beam of light is modulated by gratings and the complete valving is accomplished by a deflection of the oscillograph mirror. The mirror is vibrated through an exceedingly small amplitude just sufficient to valve a single beam so that the combined illumination, by collecting several hundred thin beams, produces a brilliant spot on the television scanning disc. Only low power is required with this system and a spot of pure white light of good brilliancy is secured.*

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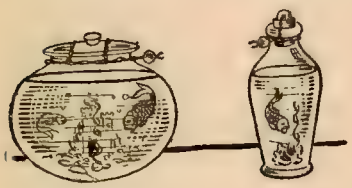
# THE EDITOR'S MAILBAG

substances and protoplasm; also that the decay of the plant and animals renders available these stores of food and energy for the bacteria and fungi; which then redistribute the energy and resolve the organic compounds into simpler substances, making them available for other cycles of energy.

"This concept is so fundamental to an understanding of the interrelations of organisms that an experimental demonstration which would impress it upon the minds of the students seems most desirable. In devising an experiment to illuminate this principle the following factors of the food and energy cycle are essential:

1.) A sufficient quantity of the elements oxygen, carbon, hydrogen, nitrogen, phosphorous, sulphur, iron, calcium, magnesium, sodium, and chlorine in an available form to permit their temporary storage in the organisms and in dead organic matter, and shall have at all times an amount adequate for the immediate needs of the living plants and animals.



2.) Green plants that will multiply rapidly and grow vigorously at all seasons of the year.

3.) Sunlight sufficient for photosynthesis, but not too intense for the rapid growth of bacteria and fungi.

4.) Animals that can derive an adequate food supply directly from the plants.

5.) Bacteria and fungi.

6.) Moderate temperatures.

"Aquatic plants and animals seem to meet these requirements to the best advantage. In laboratory practice I have found that of the available plants, the common alga. Scenedesmus can be depended upon for the combinations grown throughout the years under laboratory conditions. The common goldfish will live and thrive on this plant as a food at least for several months. Accordingly, the following experiment was set up last year and was found to work successfully throughout the remainder of the school year—seven months.

"A cylindrical museum jar 43 cm, high and 14 cm. in diameter having a total capacity of six and a quarter liters, was half filled with a mixture of three parts of tap water and one part of Moore's solution. The tap water has the following composition:

| | |
|---|---|
| Sodium nitrate | .66 mg. |
| " chloride | .86 mg. |
| " sulphate | 3.08 mg. |
| Magnesium sulphate | .90 mg. |
| " carbonate | 8.38 mg. |
| Iron " | .04 mg. |
| Calcium " | 124.80 mg. |
| Water | 1,000.00 cc. |
| Silica | 1.70 mg. |

"Moore's solution for the growing of algae is made up as follows:

| | |
|---|---|
| Ammonium nitrate | .5 gm. |
| Potassium phosphate | .2 gm. |
| Magnesium sulphate | .2 gm. |
| Calcium chloride | .1 gm. |
| Iron sulphate | trace |
| Distilled water | 1,000 cc. |

"To this was added 500 cc. of a pure culture of Scenedesmus quadricauda (Tunp) Breb. The algae multiplied rapidly and at the end of ten days a goldfish 6 cm. long was added to the aquarium. The ground glass stopper was then put on the jar and sealed air-tight with laboratory cement. The jar was placed near a west window, but screened from direct sunlight at all times. The jar was sealed on Jan. 1, 1910, and was still apparently in good condition on July 28, when an accident—allowing the jar to stand in full sunlight for a day—brought the experiment to an end by killing the fish."

*(We are grateful to you for this information and are sure that those of our readers who have tried this experiment and those science instructors in schools and colleges who are conducting the same experiment for the benefit of their pupils will appreciate this additional data.* EDITOR.)

## A "Mystic Magazine"

*Editor,* SCIENCE AND INVENTION:

I am sending you under separate cover a "Mystic Magazine." I wish you would read this magazine and express your opinion through the columns of your paper. There are some special paragraphs which I wish you would take note of. You will find on page number 311, that a writer in this "Mystic Magazine" makes a prediction of war, stating that if certain conditions prevail, other specified things will surely happen. Why, I might say there would be a rainbow visible in this locality on the 18th day of March, 1929 if there happens to be a cloud and the atmospheric condition is favorable for producing rainbows.

The editor also states on page 315 that a dead person is conscious of the lamentations of relatives no matter how far away they might be for the first two or three days after his departure from this life and that care should be taken against emotion.

The "philosophy" that is taught by this "Mystic Magazine" seems to have a large number of supporters, so I thought it might be to the interest of your readers to expose the fallacies of this sect. Ever since I became a reader of SCIENCE AND INVENTION, formerly Electrical Experimenter, I have been heartily pleased with your earnest endeavors to direct the footsteps of your subscribers into the path of truthfulness. and to expose the by-paths of falsity and fraud in which so many are prone to walk.

RALEIGH D. STRICKLAND,
Camp Hill, Ala.

*(This magazine predicts war a year from the date of issue. A year from now no one will remember this article. Of course, there are wars being waged constantly; if not between nations, then between tribes of South African or South American natives. The chances are that the predictor is correct. You might predict that war will take place at the end of this year, or the early part of next, and always be right. Even a punitive expedition could be called a war, depending entirely on how you look at it. The prediction as made depends upon a variable factor; hence, there is a still smaller possibility that the author would be wrong. If the rainbow occurs, we will have war; if it does not occur, we may have war or we may not have war. In either event, the individual drawing up this horoscope can claim his predictions as being accurate.*

*The idea that a dead person is conscious of the lamentations of his relatives for three days after he dies is not a bad suggestion to bring home. There is of course no scientific basis of truth for a statement of this nature, just the same as there is no basis of proof for a statement that the dead person is not conscious of anything that happens after death takes possession of his earthly body. This is something no scientist knows, regardless of how well educated he may be. There seems to be quite conclusive proof, however, that what occurs after death will forever remain a mystery, just the same as those things which occur before birth remain mysteries.*

*Again we may recall any of those who have practically been snatched out of the grim hands of death, after having been rescued from drowning and resuscitated perhaps an hour or so after they went down for the third time. They remember the coming to. They may remember that they went down for the first or possibly the second time, and that they called for help, but the interval between the time when they heard the music and entertained pleasant dreams until that time when they were gradually coming back to consciousness is a complete blank. In view of this, perhaps death has not the proverbial sting attributed to it.*—EDITOR.)

## Exposés

*Editor,* SCIENCE AND INVENTION:

I enjoy seeing some one exposed who is robbing poor innocent people. If any one with even a high school chemistry course had looked at the "Ionaco," they could have told you it was all the bunk. The way they advertised it, claiming it to cure every disease heard of, was enough to show it up. Some time ago I saw in a magazine an article written by a prominent physician, warning the public that if the medical world knew a cure for cancer (which I believe the Ionaco was supposed to cure), they would surely let it be known, and cure some of these people that are not expected to live the year through.

ADDISON G. HARDEE,
Palmetto, Fla.

*(Many quack remedy manufacturers publish and broadcast talks against the medical profession and the American Medical Association. Every excuse for an attack has been used, every cudgel employed to interfere with the excellent work of spreading the truth. The statement that a physician would give to the world any news concerning the discovery of a cure for any disease is correct. Insulin is only one example.*

*Not so very long ago this editor was requested to investigate a diagnostic machine, by three of the state's most prominent medical men in the profession, and these men were also leaders of several local medical societies. The surprising part is not that they were more than ready to be convinced of the operation of the diagnostic machine, but they were even eager to purchase or lease such an apparatus at a fabulous price. These men had given the operator three samples of blood to be "diagnosed." The blood came from ill patients. The diagnosis were correct in each instance.*

*Following a conference, the machine was once more tested and failed in dozens of cases. The reason was obvious—the "spy" was prevented from seeing hospital records of the patients hence he could only hazard a guess. This merely indicates to what extent medical men and societies will go in order to arrive at the truth. Were we confident that the machine would even give an approximate reading which could be consistently repeated for the same cause or illness,* SCIENCE AND INVENTION *would have had a story, and the medical world a new science. Research to improve such a machine would keep all the medical doctors busy for the rest of their lives. So when a person broadcasts anti-medical propaganda, just pry into the merits of his own panaceas and find out what he is selling.*

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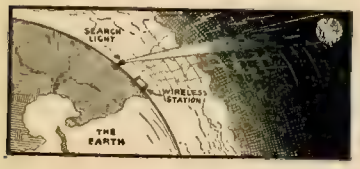
# READERS FORUM—

**SCIENCE AND INVENTION desires to hear from its readers. It solicits comments of general scientific interest, and will appreciate opinions on science subjects. The arguments pro and con will be aired on this page. This magazine also relishes criticisms, and will present them, whether caustic or not. So if you have anything to say, this is the place to say it. Please limit your letters to 200 words or less, and address your letters to Editor—The Readers Forum, c/o Science and Invention Magazine, 230 Fifth Avenue, New York City.**

## Communicating with Mars

*Editor,* SCIENCE AND INVENTION:

Here is an idea that seems to have been overlooked by many experimenters and scientifiction writers: It is impossible to communicate with Mars by radio in its present form because of the intervention of our old enemy—static. The surface of Mars is a very dry desert and the only place on earth having similar atmospheric conditions is northern Chile. At the Smithsonian solar observatory in Chile, it was found that radio reception was entirely impossible at any time because of the continuous and uproarious static. It is evident that any possible Martian radio system would have to be entirely different from ours.




The fact that light passes through the Martian atmosphere with little interference suggests that very short wavelengths might be used there. It would be interesting to learn just how high up the scale of frequencies the common static disturbances go. There must be a virtual limit somewhere because static electricity only produces light and heat under exceptional conditions. On Mars the reflecting layer in the upper atmosphere is lower than it is here and its curvature is greater.

JOHN B. PLATTS,
Wallace, Idaho.

*(Is it not possible that in spite of the fact that static may be uproarious on Mars, that the Martians, because of their greater advancement along the evolutionary field—assuming, of course, that they have advanced as rapidly as people on this earth—may likewise have improved radio to such an extent that static does not bother them in the least? That being the case, there should be no difficulty in communicating via radio. They may likewise be using frequencies there either much greater or infinitely smaller than ours for communication. Perhaps by this time they have evolved systems of communication which dispense with radio entirely.*

*There is, of course, only one objection to the possible use of radio in interplanetary communication, and that is whether the Heaviside layer acts as a perfect insulating medium or whether this reflects only waves of certain frequencies and passes others. It may also produce a condenser effect and the opposite side of the layer may be charged by a charge on the inside.*

*Of course, there is no objection to the use of light. This could always be employed for interplanetary communication. Such a system entails expensive installations.*

*It may also be that the Martians have telescopes of such gigantic power or size that they can see that life actually exists on this planet. Surely the construction of the Erie Canal or the Panama Canal or the evolution of a city of any size becomes an observable fact. Vast forest fires might likewise be recognized. Perhaps the Martians communicated with this earth or attempted to do so thousands of years ago and have long since given up hope of possible communication. Then, on the other hand, these same Martians may never exist. We can merely conjecture.—EDITOR.)*


## IN FEBRUARY "AMAZING STORIES"

**THE CAPTURED CROSS-SECTION, by Miles J. Breuer, M.D. By mathematics, one Simon Newcomb, an eminent scientist, proved the impossibility of flying machines. By mathematics, many a scientific theory has been proved and disproved equally absolutely. The Fourth Dimension is no exception. In this story, the scientist not only does a lot of interesting figuring, but he actually introduces an entirely new method to supplement his figures, which seems quite plausible, and in the story, at least, proves very effective. Dr. Breuer knows what he wants to say and knows how to say it. He keeps the reader in complete absorption and anxious suspense to the very end.**

**THE SIXTH GLACIER, by Marius. A serial in two parts (Part II). In the concluding chapters, the author continues his story in the same engrossing manner, to tell about the further devastations caused by the still fast oncoming glaciers, while the earth still moves in the frigid volume of space. Why and how the world is finally rehabilitated is well told in gripping detail.**

**PHAGOCYTES, by A. H. Johnson. Until comparatively recently, or more specifically, until William Harvey, the scientist, discovered it, we knew nothing about blood circulation. This story deals with just this subject in such a manner that you get 99% good information in a most delectable manner. Perhaps there will be more stories telling us what is going on in the great mysterious machine we call "The Human Body." We recommend this unusual "story" heartily.**

**MERNOS, by Henry James. Seven new planets were discovered in 1928. Professor Pickering is supposed to have found an extra Neptunian planet far beyond the orbit of Neptune, and he gives its diameter, its mass and its orbit, though it has not been found by the telescope. "Mernos" is a charming interplanetary extravaganza about a new—thus far undiscovered—planet, which will delight the reader.**

**And others.**


## A Bouquet Plus

*Editor,* SCIENCE AND INVENTION:

Exactly ten years ago today I bought my first copy of one of your magazines, the August, 1918, *Electrical Experimenter.* Since that time I have been as regular a patron of your publications as the finances of a small town poor boy student would permit, and I shall continue to be so. I felt it only proper to write you a letter upon this anniversary.

I still have the old copy of the *Electrical Experimenter.* At the present time it is dog-eared and tattered. The cover came off long ago, and now lies folded inside. When I found it the other day I spent a half hour looking it over, for it was the first magazine I ever bought. I was nine years old then. It was a hot day and I rode into town on the wagon with my father. He gave me a quarter to spend, more than I ever had before, except in my little bank. In the drug store I looked over the candy counter and the list painted in whiting on the mirror of the soda fountain. It was so hard to decide how I wanted to invest my fortune. When I progressed as far as the magazine racks I saw the mono-flier on the cover. And so I bought that magazine and proudly carried it out. I can still remember the puzzled look on the drug clerk's face when I asked for it.

I read that magazine through and through. Except for religious magazines, it was the only literature in the house besides the newspaper. Your story, "The Magnetic Storm," was long a puzzle, because it was the first bit of fiction I had ever encountered, and it was not labeled. (If it had been, the magazine would probably have followed a "Boy Scout" book a neighbor gave me the preceding Christmas, into the stove.) I hardly understood a fourth of the rest of the magazine, but what I did understand persuaded me to buy another copy the next time I had a chance, which happened to be the next June.

It would be an untruth to state that this magazine changed my course in life. Yet I believe it was the first factor to direct my attention to something nearer than heaven. My scientific knowledge since that time has always been ahead of that of others of my age whom I know. At present I do not intend to pursue any branch of science (due to my financial situation) but I may in the future. Such knowledge as I have I find extremely useful, however. In every issue of SCIENCE AND INVENTION I find facts which increase my opinion of it. Though I now regularly read eight magazines, I am always eager to get my first love. And I would hardly consider it right to let this day go by without telling you that an old reader appreciates your work and thanks you for your attempts to popularize science.

JOSEPH M. WILSON,
Gridley, Ill.

*(We are certainly glad to have had you as a reader for ten years, and we hope that you will continue to read this publication for many times that number of years more.*

*Well, we promised to publish bouquets and brickbats. This letter, no doubt, belongs to the former class and try as we may, we cannot think of anything to insert, into what should be an editorial comment. All we can say is "thank you."—EDITOR.)*

## Sealed Aquarium

*Editor,* SCIENCE AND INVENTION:

In view of the "Sealed Aquarium—A Microcosm" article which appeared in the September issue of your magazine I thought that you might be interested in the enclosed article. This report, as indicated, appeared in the journal of "School Science and Mathematics" in 1911 and was written by E. N. Transeau, now Professor of Botany in Ohio State University.

"The great food and energy cycle of living organisms has come to be an increasing and important topic in most courses in biology. The more recent text-books contain the familiar diagram in one form or another which shows that green plants absorb certain inorganic substances and by the use of the sun's energy elaborate the food for all plants and animals; that this food is used either directly for the liberation of energy or temporarily stored in the form of more complex

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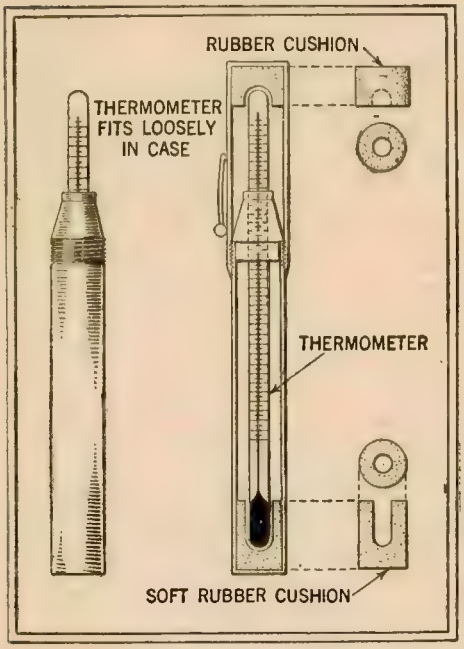
# and FORMULAS

Edited by S. GERNSBACK

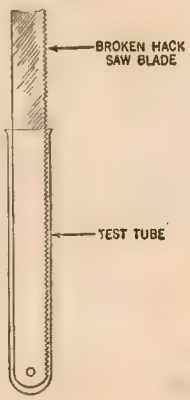
## Thermometer Case



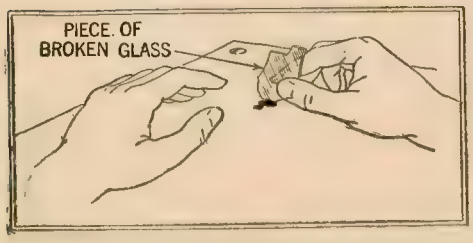

*A neat case for a pocket thermometer can be made from an old fountain pen as shown. A soft rubber eraser is cut to fit the upper and lower halves of the barrel. If the pen has a large barrel, the ink container can be used as a soft cushion. The thermometer should be fitted to slip out easily.—H. R. Wallin.*

## Test Tube Cleaner

*An old hacksaw blade can be used for removing solids from a test tube. The teeth will readily scrape away any brush resisting solid formation. If desired, a wooden handle may be placed on one end of the blade and will provide a handy grip.—Wirtie Rermsburg.*




## Ink Eraser




*A piece of broken glass makes a good substitute for steel erasers when removing ink blots. The sharp edge of the glass will scrape the surface of the paper, effectively removing the blot. A piece with a round edge should be selected.—Juan Estolas.*

## Yellow Sympathetic Ink

Take a thin piece of copper sheeting, about two inches square and heat it over a flame until the metal surface has become coated with a black film. Put the blackened piece into a saucer containing some strong vinegar, and set saucer in a warm place for an hour or two. Before long a green deposit will form upon the copper. Let most of the vinegar evaporate and then wash the green residue off of the copper into the remaining vinegar and strain this through cheesecloth into a container to get a clear liquid. Add a few drops of ordinary household ammonia to this liquid until it changes to a blue color.

In writing with this solution it will appear as a very faint blue color on the paper, but on holding the paper over a stove or a flame, the writing will be seen to change to a yellow.—*Contributed by Kenneth S. Richardson.*

## How to Make "Sparklers"

Cover an ordinary match halfway up from the head with glue. Very little glue should be put on so as not to stop the match from burning. Daub the match with iron powder, and shake off the excess. When dry, the match is ready to be used. All you have to do is to strike the match.—*Contributed by Frank Schmulawitz.*

## Scorched Clothes

If clothes are scorched in ironing, I wet the scorched part, and cover with cornstarch, then rub in well. When dry I remove the cornstarch and all trace of scorch will be removed.—*Contributed by W. S. Fogg.*

## Cleaning Spots on Velvet

To clean spots on velvet, cover a flat stick with a pad of velvet and rub this on the spot the way of the grain.—*Contributed by E. L. Dunbar.*

## A Photographic Kink

The following is a good method for obtaining orange and black tones on ordinary printing-paper:

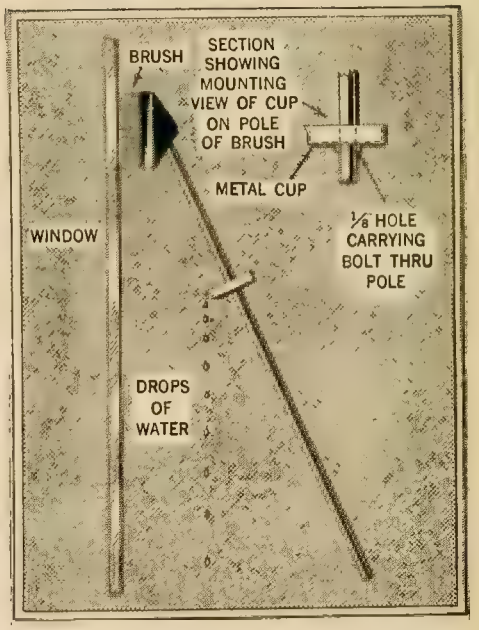
The printing-paper is exposed and the picture developed in the usual manner, but before placing it in the Hypo, it is exposed to the *sunlight* until the white parts turn a deep orange. It is then put into the Hypo as per usual, followed by a *thorough* washing. The Hypo bath lightens the orange a trifle, therefore it is best to let the sunlight turn it a trifling shade darker than desired. Ferrotyping will not destroy the color.

It is ideal for firelight scenes.—*Contributed by Jack H. Thelin.*

## Heat from Radium

The heat produced by radioactive salts may be detected as follows: Wrap some radium barium chloride or other radium salt around the bulb of a thermometer with a piece of cotton, noting the temperature. After a short time, the mercury will be found to rise several degrees.

## Window Brush Kink



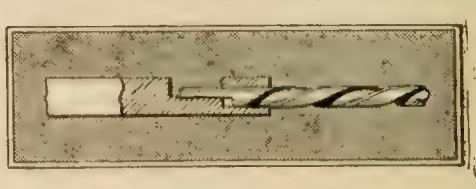

*Water can be prevented from running down the pole of a window brush by taking the top of a can drilling or cutting a hole in the middle and fitting it over the handle or pole of the brush as shown.—F. R. Moore.*

## Hanging A Clock

*A wall clock can be hung straight by using the method outlined here. The clock is hung on the wall with the pendulum at rest and the bottom moved to the right until a click is heard. A mark is made on the wall using any point on the clock case, shown at C. The bottom is then moved to the left and the same procedure undertaken. The space between the two points A and B is then divided in half, and the clock moved until the point of the case used previously is at this position.—Jacob Schmidt.*

## Extension Drill

*A simple method of making an extension drill is shown in the drawing. The shank*



*is filed or milled half of its diameter, and the extension milled about one-half inch from the edge. The flat on the extension acts as the driver and the flat portions prevent the drill from turning.—J. McIntyre.*

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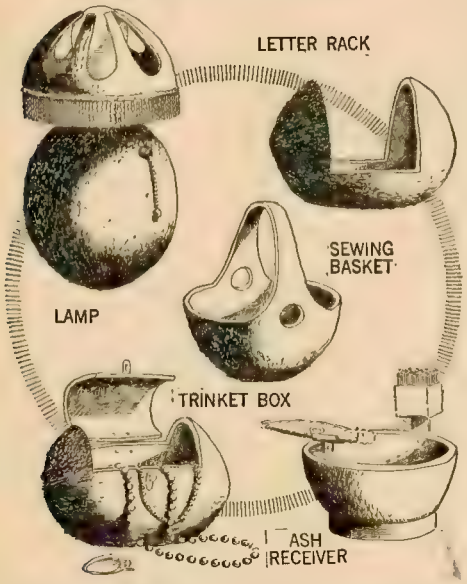
# WRINKLES, RECIPES

## Cocoanut Novelties

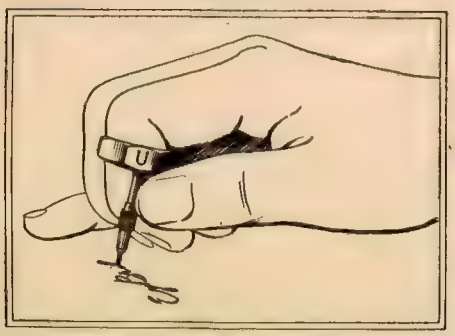



*Cocoanut shells can be made into a number of useful articles and are easily worked. The shells can be finished in a number of ways. The above illustration shows only a few of the novelties made from the shells.*
*—Harold Jackson.*

## High Voltage Condensers

*Hold the tip of an electric light bulb under the surface of a salt water solution and file off the tip. Wipe dry and seal with sealing wax. Wrap a sheet of tin or lead foil around the outside and a high voltage condenser is made. A number of these condensers can be connected together as shown.*
*—Raymond B. Wailes.*

## Ring Pencil



*By the combination of a small lead holder with a metal ring which slips over the finger, the annoyance of lost pencils is obviated. The ring pencil is shown above.*
*—G. Solkover.*

## Cleaning Typewriter Type Faces

Most typists in cleaning the type faces of their typewriter use a varied collection of materials, running from a can of benzine to a bent hairpin. A much simpler and cleaner method can be provided by the use of an ordinary blotter. Insert the blotter into the typewriter. Then throw the keys into "stencil" position by the operation of the mechanical device which controls that feature.

With the keys in stencil strike each key several times. Make the touch rather heavy and the blotter will absorb all superflous ink and dirt from the type. If the grime in any particular letter proves stubborn, a pin or needle can be used to remove it. When the type leaves nothing but the clean stencil pattern on the blotter, that type is clean and you are ready for the next one.—*Contributed by Robert Gregg.*

## Preventing Steel Tools Getting Rusty

I find that if steel tools are rubbed with a warm, fairly dense solution of copper sulphate, they will not rust easily if left undisturbed for long periods.—*Contributed by W. E. Colbath.*

## Drilling Holes in Razor Blades

Drilling holes in safety razor blades is by no means as easy as it sounds. Recently I tried the following stunt and it works fine. Take two leads from a six volt battery or generator and connect them to the blade. One lead may be clamped to the blade, while the other is used as a point. Remove as soon as the marked spot becomes red. The same method may be used on clock springs.—*Contributed by Oscar C. Olson.*

## Miscellaneous Wrinkles

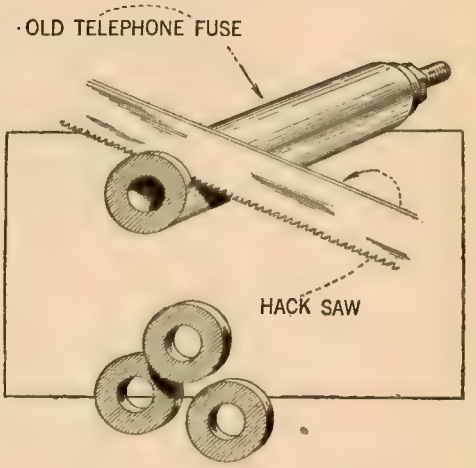
The leather covering on arch-supports can be preserved, cleaned and made almost immune from cracking by the frequent application of high grade shoe polish.

To prevent sticking and to enable furniture drawers to slide easily, nail a small drawing or push-pin at front end on top surface of drawer runner, on the track made by sliding of drawer. Drawers will readily glide on the polished surface of pin.

To produce a clear smooth edge on tin or zinc, scrape the edge with an old scissors blade, this will remove all roughness and is quicker and more efficient than filing.

When cutting a number of paper patterns and accurate results are required, place pieces of paper on a piece of glass; lay the master pattern in position on paper and cut carefully around by using a sharp pointed knife; every piece will be true and the knife point will not be dulled. When a number of pieces of paper are cut with scissors at the same time, no matter what the care that is taken, the lower pieces will be untrue and usually longer than required,—*Contributed by J. D. Calvert.*

## Fibre Washers

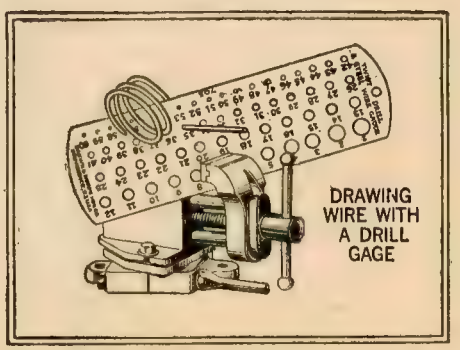



*Insulating washers can be made from an old telephone fuse by holding it in a vise and sawing off pieces as shown. Any desired thickness can be made for various purposes. The fibre tube of a telephone fuse is very solidly packed.—Harold Jackson.*

## Straightening A Tree

*A leaning tree may be straightened to an upright position in a short time by using a tent guy-rope and a peg as illustrated.*
*—Fred Cornelius.*

## Drawing Wires




*Soft metal wires can be reduced in diameter by drawing through a drill gauge as shown.*
*—George Solkover.*

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# WOOD-TURNING

By H. L. WEATHERBY

ARTICLE NUMBER 8 IN A SERIES

## A LANTERN-TYPE FLOOR LAMP

NEARLY everyone who has a lathe wishes at some time or another to turn something that is longer than his equipment will permit. Oftentimes, too, we hesitate to turn long, slender articles because of the vibration that goes along with such turning. By breaking such work into divisions or sections, however, it is a simple matter to turn long work in a short lathe and after it is assembled and glued together, no one but the maker will be the wiser.

### *Turning a Floor Lamp*

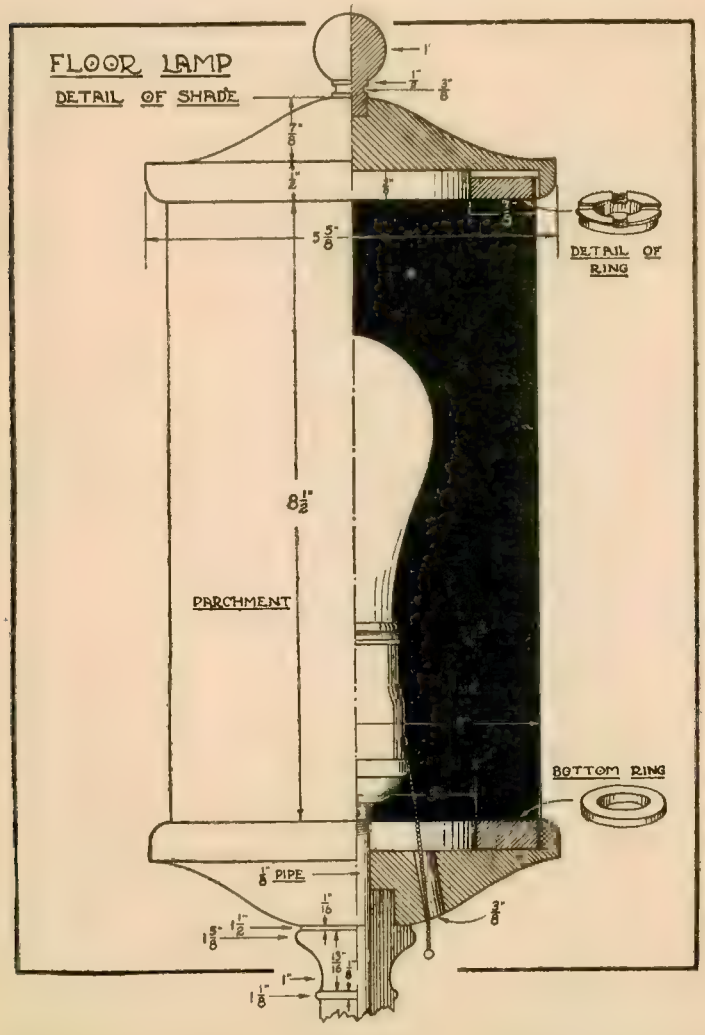
WE offer this month, for the readers of these articles, a floor lamp of the lantern type, which is so popular at this time. The standard is a long slender column broken into two or three pieces and fastened together with round mortise and tenon joints. With pieces of the length indicated for half the post there will be more or less vibration, but aside from that no difficulty should be experienced in the turning.

### *Preparations of Material*

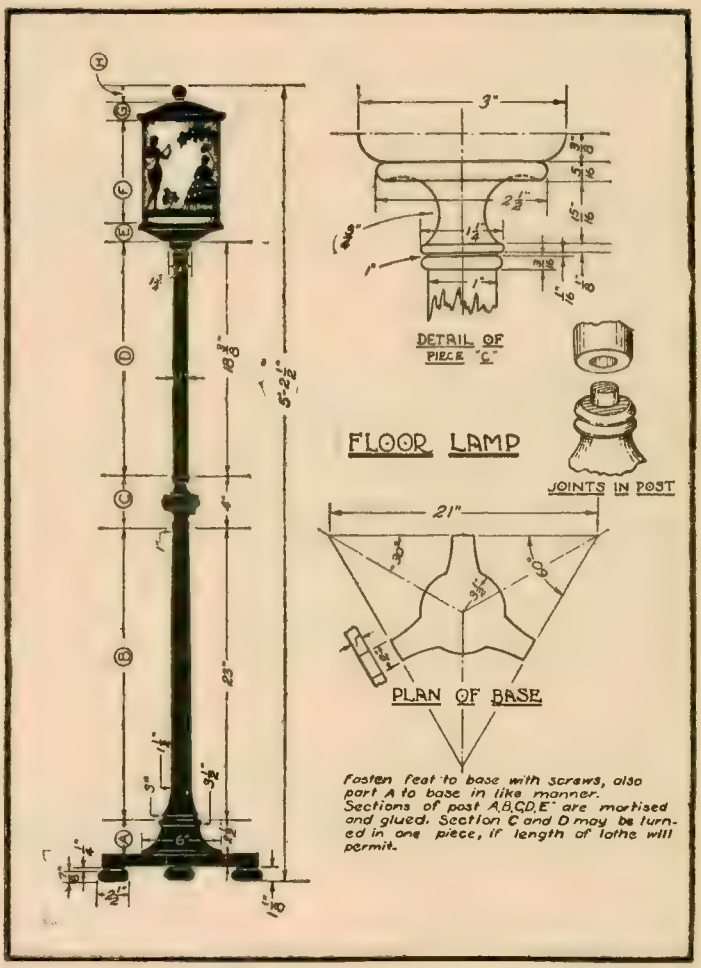
ALL of the pieces for the standard or column should be glued together as the photographs indicate with a groove down the center to care for the cord. It would be impossible to bore these sections, therefore the hole must be made in the manner indicated and plugs glued into the ends of the holes to permit centering in the lathe. This groove may be cut with a machine saw if available, or with a combination plane, or evenly with a chisel if none of the other tools are at hand. Cutting with a chisel will prove a laborious procedure and should be avoided if possible.

When these grooves have been cut and plugs for each end of each section prepared and the faces smoothed, glue the parts together, being careful to get sufficient pressure with the clamps to insure a good joint. After the glue has been allowed to set the sections are ready for turning.

One end of each piece should carry a mortise while the opposite end should have a corresponding tenon to fit into the mortise of the next piece. These mortises should be bored with a three-quarters to one-inch bit to a depth of about one inch. The centering on the lathe should be done then with the dead center set into the mortise, being careful to center exactly.




*The details of the shade for the floor lamp are shown above. The parchment is glued to a ring at the top and bottom, and the cap and base fastened to these rings.*


DETAIL OF PIECE "C"
FLOOR LAMP
JOINTS IN POST
PLAN OF BASE
Fasten feet to base with screws, also part A to base in like manner. Sections of post A,B,C,D,E are mortised and glued. Section C and D may be turned in one piece, if length of lathe will permit.

*The above illustration gives the dimensions of the stand and base. The pieces for the post are glued together with a groove in the middle which should be plugged at both ends for centering in the lathe.*

For those who have followed these articles, the actual turning of the post itself calls for no detailed explanation.

### *The Base*

THE pattern for the base should be laid out first on a piece of paper or cardboard, cut out and marked around on a twelve-inch square piece of wood, which is one inch or slightly more in thickness. It should be cut close to the line with a band-saw or hand-turning saw and smoothed carefully to the lines with file and sandpaper.

The feet can be turned separately or all at one time. Holes should be bored and countersunk on (*Continued on page* 983)

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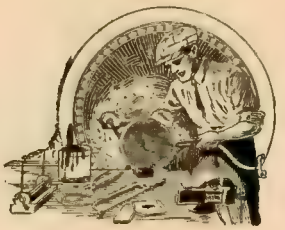
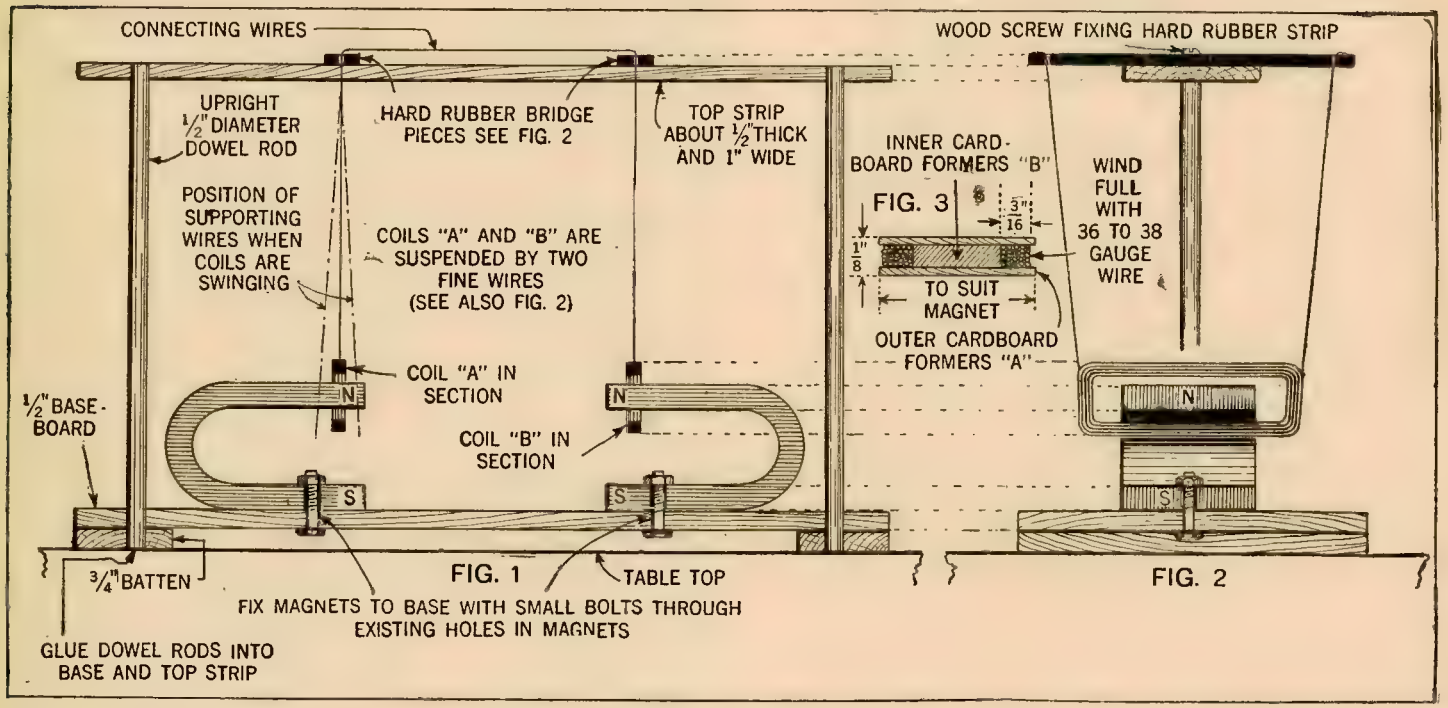
# HOW TO MAKE IT



## *Building An Electrical Mystery Pendulum*

By C. A. OLDROYD

**The generation of an electric current by induction and its conversion into motive power can be demonstrated in the simple experiment described here, which also illustrates the principle of the dynamo.**


CONNECTING WIRES
UPRIGHT ½" DIAMETER DOWEL ROD
HARD RUBBER BRIDGE PIECES SEE FIG. 2
TOP STRIP ABOUT ½" THICK AND 1" WIDE
POSITION OF SUPPORTING WIRES WHEN COILS ARE SWINGING
COILS "A" AND "B" ARE SUSPENDED BY TWO FINE WIRES (SEE ALSO FIG. 2)
COIL "A" IN SECTION
COIL "B" IN SECTION
½" BASE-BOARD
¾" BATTEN
FIG. 1
TABLE TOP
FIX MAGNETS TO BASE WITH SMALL BOLTS THROUGH EXISTING HOLES IN MAGNETS
GLUE DOWEL RODS INTO BASE AND TOP STRIP
WOOD SCREW FIXING HARD RUBBER STRIP
INNER CARD-BOARD FORMERS "B"
FIG. 3
3/16"
1/8"
TO SUIT MAGNET
OUTER CARDBOARD FORMERS "A"
WIND FULL WITH 36 TO 38 GAUGE WIRE
FIG. 2

*Two permanent magnets are mounted as shown in Fig. 1. Similar poles should face each other. The magnets are "U" shaped. Above in Fig. 2 is shown how the coil is suspended over one of the poles and Fig. 3 gives the details of the coil.*

AVERY long time ago, Michael Faraday demonstrated to his fellow-scientists that when a closed coil of wire is passed over a permanent magnet an electric current is induced in the winding.

This principle is the basis on which our dynamos are designed; it also lends itself to a fine experiment—"The mystery pendulum." The generation of an electric current by induction—and the conversion of electric energy into motive power—can be demonstrated in a beautifully simple fashion.

Two large permanent magnets are needed for this experiment, they are "U" shaped. Such magnets can be easily obtained from discarded magnetos, (Figs. 1 and 2.) The two magnets are mounted on a wooden baseboard as indicated in Fig. 1, with their similar poles facing each other. (N opposite to N.)

Magnets from a magneto have already suitable mounting holes for the bolts; if undrilled magnets are used they may be clamped to the base with a cross piece over the lower leg.

Over the upper leg of each magnet, near its free end, a coil is suspended; this coil is shown in section in Fig. 3, and has many turns of fine wire.

Start and finish of the winding are used to suspend the coil from small hard rubber bridge pieces (see Fig. 2) mounted on the upper surface of the wooden top strip. In this way, the coils can swing from the suspension wires, like a pendulum.

The start of winding of coil "A" is connected to start of winding of coil "B," similarly the finish of one winding is connected to that of the other coil.

When the complete apparatus is set up, start coil "A" swinging by giving it a gentle push, (Fig. 1.) It will travel over the end of the N leg of the magnet as shown by the dotted lines.

As the coil swings, currents are induced in the winding, these are transferred through the connecting leads to the other coil "B." Consequently, coil "B" will begin to swing on its own account. "A" is the generator and "B" the motor.

Coil "A" will soon begin to slow up while "B" swings with increasing amplitude; when both coils have the same extent of swing they will carry on until they both come to rest at the same time.

If the leads from one coil to the other are crossed, that is, if the start of one winding goes to the finish of the other, the coils will swing 180 degrees out of phase.

The only point to be watched in this experiment is that the distance from the suspension bridge piece to the top of coil must be equal for both coils "A" and "B."

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**Simple Instrument for the Amateur Star Gazer Constructed at Home**

# Refracting Telescope Can Be Built at Small Cost

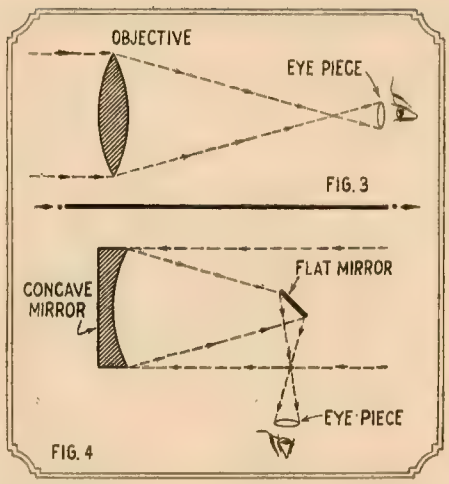
By DONALD H. MENZEL, Ph. D.

THE person who attempts to build his own telescope must first consider the following questions:

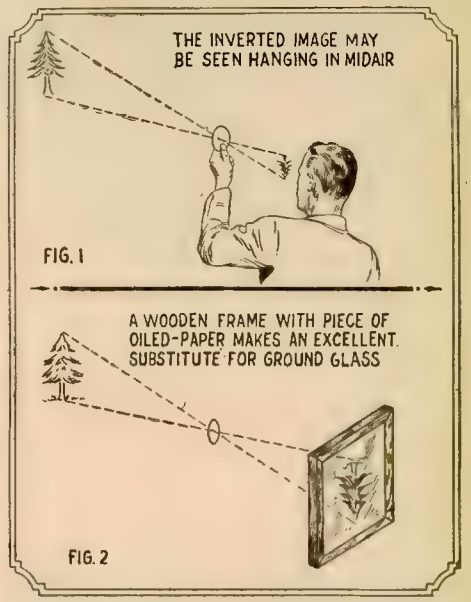
1. For what purpose is the telescope designed? Is it to be used for critical astronomical observation, or just "looking around" the sky? If the former, much more perfect lenses are, of course, required and the cost of the instrument accordingly increases. This leads us to consider question number two.

2. How much money are you willing to spend—$5.00, $50.00, or more?

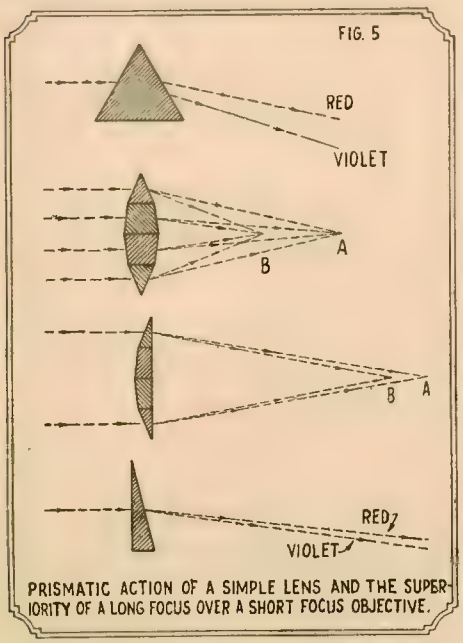
In this article I shall try to tell you how to build the best telescope possible with the least expenditure of money. Since I advocate your using any old lenses that may be in your possession, the resulting instrument may take on an almost infinite variety of forms. Hence it seems better to delineate certain general features common to all telescopes so that anyone with ingenuity can devise the best instrument he can from whatever material may be at hand.




*The principles of the two types of telescope, refracting and reflecting, are shown in diagram on the left.*


THE INVERTED IMAGE MAY BE SEEN HANGING IN MIDAIR
FIG. 1
A WOODEN FRAME WITH PIECE OF OILED-PAPER MAKES AN EXCELLENT SUBSTITUTE FOR GROUND GLASS
FIG. 2

*If the eye is placed about ten inches behind the focus of a convex lens, the inverted image of the object will seem to hang in midair. Oiled paper makes a good substitute for ground glass.*




*White light, if passed through a prism, is broken up into the rainbow colors, the blue rays being bent more than the red. The prismatic action of a simple lens and the superiority of a long focus over a short focus objective may be seen above.*

### *The Workings of a Simple Telescope*

FORTUNATELY, a telescope is not a very complicated piece of machinery. Its principal, and most expensive part, is the image-forming device. When light passes through an ordinary convex lens, the rays are bent or refracted to a focus. If the eye is placed ten or so inches behind this focus, an inverted image of the object looked at may be seen hanging in midair (Figure 1) or it may be viewed on ground glass. If no ground glass is available, a piece of white oiled paper (or heavy tissue paper) tacked to a wooden frame (Figure 2) is an excellent substitute. Thus far, a telescope and camera are seen to work on the same principle.

At this point, I wish to correct a common misconception. A person does not look *through* a telescope; he looks at the image formed by the main lens. The average eye cannot comfortably adjust itself to a distance much nearer than ten inches. If the distance from the eye to the image is just equal to the distance from the focus to the lens, the so-called focal-length, the telescope will not magnify at all. Magnification is accomplished by bringing the eye closer, but in order to accomplish this, a second lens must be used (e.g., a small hand-magnifier). If this has a focal length of say one inch, the eye can be brought ten times as close as before, and the magnifying power of the resulting telescope will be ten.

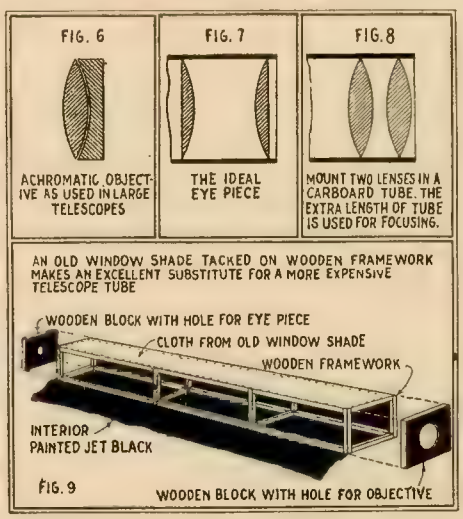


FIG. 6
FIG. 7
FIG. 8
ACHROMATIC OBJECTIVE AS USED IN LARGE TELESCOPES
THE IDEAL EYE PIECE
MOUNT TWO LENSES IN A CARBOARD TUBE. THE EXTRA LENGTH OF TUBE IS USED FOR FOCUSING.
AN OLD WINDOW SHADE TACKED ON WOODEN FRAMEWORK MAKES AN EXCELLENT SUBSTITUTE FOR A MORE EXPENSIVE TELESCOPE TUBE
WOODEN BLOCK WITH HOLE FOR EYE PIECE
CLOTH FROM OLD WINDOW SHADE
WOODEN FRAMEWORK
INTERIOR PAINTED JET BLACK
FIG. 9
WOODEN BLOCK WITH HOLE FOR OBJECTIVE

*Illustrated above is the ideal eyepiece. Constructor can make a good one with two lenses. A substitute for a telescope tube is also shown.*

A telescope, then, includes lenses, the objective, and an eyepiece. The magnifying power, M, of any such combination of two lenses can be foretold by dividing the focal length, F, of the objective by the focal length, f, of the eyepiece. Mathematically:

$$M = F \div f = \frac{F}{f}$$

An instrument of this construction is known as a refracting telescope or refractor (Figure 3). Instead of using an objective, it is possible to employ a concave mirror to focus the light. A telescope that is built on such a principle is known as a reflector (Figure 4). It requires considerable thought before one decides which type to build. A good mirror is much less expensive than a good lens of similar efficiency, but the price of either is (*Continued on page* 1001)

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# THE CONSTRUCTOR

# Building a Reflecting Telescope

By ERNEST W. BLANDIN

TELESCOPES are divided into two classes, namely, refracting and reflecting. This article deals with the reflecting type. It is possible for one having patience to produce the costly parts of a very powerful reflecting telescope. The part holding the center of the stage in this respect is the *concave mirror*.

Having obtained two glass discs of 6 inches diameter and 1 inch thickness, we fasten one to a solid bench in such a manner that the upper part will be unobstructed, and so that the glass can be rotated from time to time. Five grades of carborundum granules are now used in succession on this glass which is known as the tool and which produces a concave surface on the glass above. After each grade is finished everything is carefully washed in order that coarse cuts will not be made on the glass after finer grades of abrasive have been used.

The glass is cut by placing the granules between the two glasses, adding a bit of water and giving a back and forth motion with some pressure to the glass, rotating it a small angle every few minutes in order that grinding may be uniform.

The focal length of the mirror should be approximately determined with the first carborundum used and finished on the second and third grades. If you want a 50-inch focal length, which is usual on this size, you measure an 8½-foot cord, fasten one end to a wall at about the height of your eye above the floor. Now have someone dip the glass in water without touching the ground surface and place it on a support near the cord, with ground surface toward you. With a light held near your eye you will catch the reflection and this reflection will move from side to side as you move thus. If you are too close to the glass its motion will be the same as yours, if too far away then it will appear opposite yours. When you are at the center of curvature you will see only a flash of light. This point should be very slightly over 8 feet 4 inches when the third grade is finished. The last three grades should be used as follows: third, thirty minutes; fourth, forty minutes; fifth, forty minutes.

The glass is now ready for an emery finish which should be of over an hour in duration. Near the end of this period the glass and tool should be washed and finishing done with extra fine emery separated by stirring the fine emery with water, allowing this to stand for from 45 minutes to an hour, siphoning off the water and allowing this to stand for a day. The extra fine emery will settle and can be obtained by removing the water.

Every particle of grinding abrasive must be left behind when polishing begins. Coal tar mixed with a bit of turpentine, heated and poured over the glass tool forms the polisher. The turpentine is generally added just before pouring, to avoid igniting it while heating the tar. The glass is covered with optician's rouge in paste form and pressed on the tar shortly after being poured. The glass tool should be warmed in water, dried and wiped with a cloth having turpentine on it just before pouring the tar.

In order that the rouge may reach all parts of the glass, grooves are cut off center in the tar as shown in the photograph. These can best be cut by placing the tool in warm water every few seconds while cutting. A full day will be required to polish the glass. The same back and forth stroke is used in polishing, only the stroke should not be over two inches long, otherwise the center will polish too rapidly and great difficulty will be found when the parabolizing of the glass is begun.

*The above photograph shows the completed reflecting telescope built according to the directions given here.*

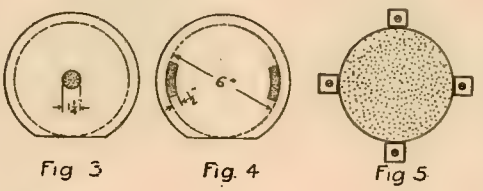

Fig. 3 Fig. 4 Fig. 5

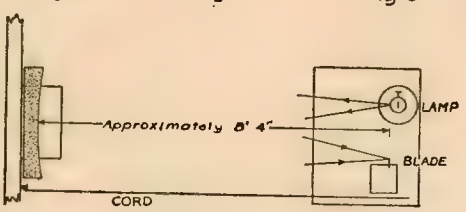


Fig. 6

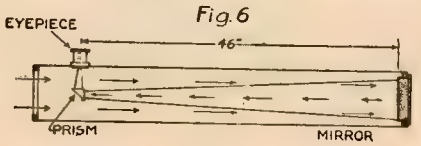


Fig. 7

*Above—Figs. 3 and 4, cardboard stops for mirror; Fig. 5, glass tool; Fig. 6, arrangement of testing apparatus; Fig. 7, arrangement of telescope parts.*

### *Testing Curvature of Mirror*

PARABOLIZING a speculum consists in polishing it to a uniform surface so that when mounted in a tube and pointed at a star all parts of the surface will reflect the light from a point in the heavens to a point on the focal plane and hence through the eye-piece into the eye. When it is accurately parabolized, each point on its surface is like one of an army of "bees," each gathering a tiny ray of light and placing it where the eye can feast on beauties too far away to be even perceived by the unaided eye. It is

(*Continued on page* 1003)

Fig. 1

Fig. 2

*Fig. 1, above, shows knife-edge shadow of parabola, and Fig. 2, of ellipsoid.*

*Above—The tools and apparatus used for grinding and polishing the glass.*

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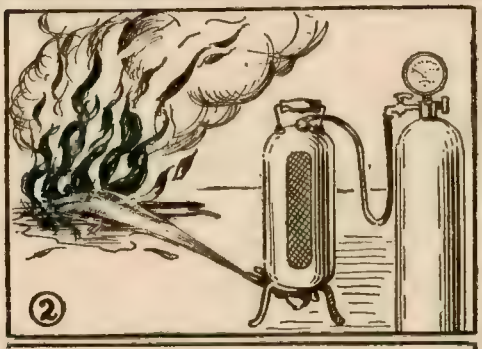
# Everyday Chemistry

By RAYMOND B. WAILES

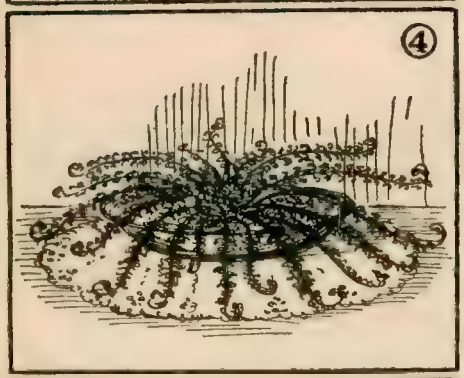
(Answers to the Everyday Chemistry questions on this page will be found on page 974)

1. Having seen the hard shells on seeds, would you believe that a seed could possibly "breathe?"

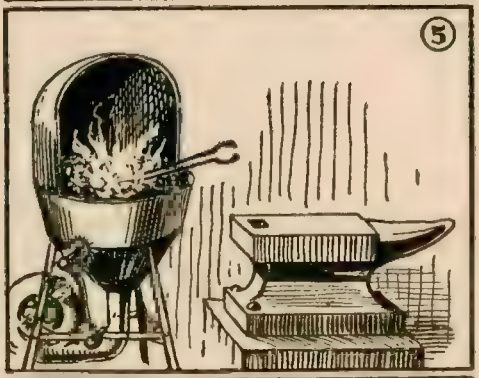



2. Oil fires are quite difficult to put out. Do you think that they can be put out with water to which a few cheap chemicals are added?

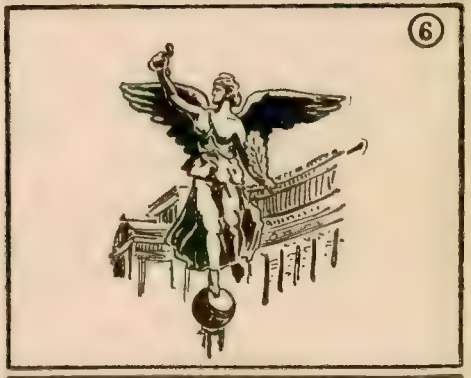
3. Peanut shells may be useful for housing the peanuts, but do you know some of the other uses for these shells?



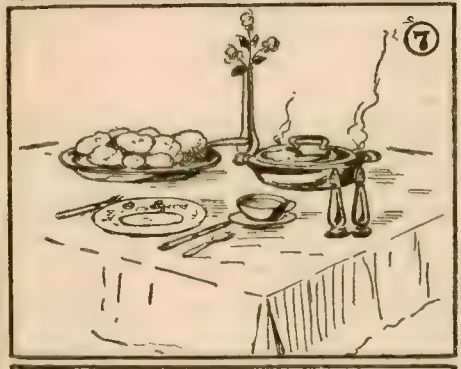

4. Resurrection plants are known by many. Are the assorted colors, such as violet, red, green, blue, orange and pink, in which they now come, natural?



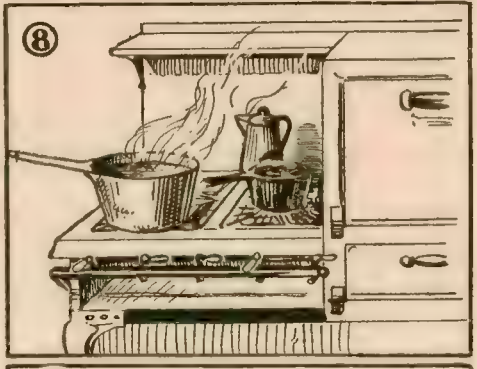

5. Those working with metal know of case-hardening powders. Do you know of what these powders consist?



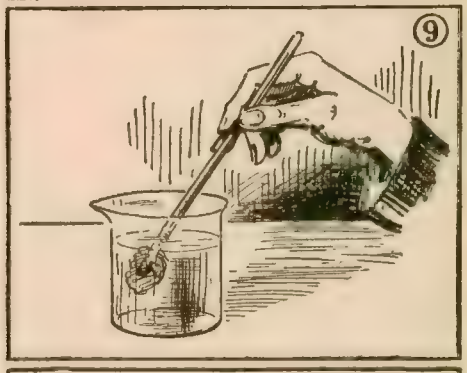

6. Statues disintegrate, but coal fires help cause this disintegration. Do you know in what way they do it?



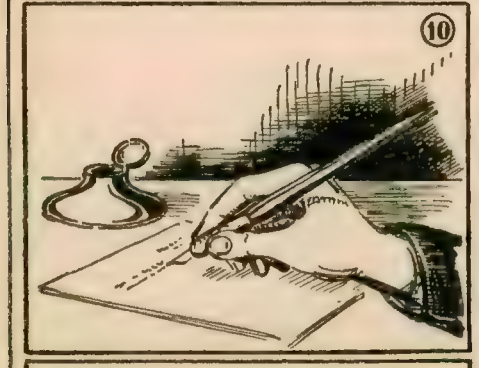

7. Have you ever given a thought to the cause of the black looking bitter potatoes sometimes unavoidably served?



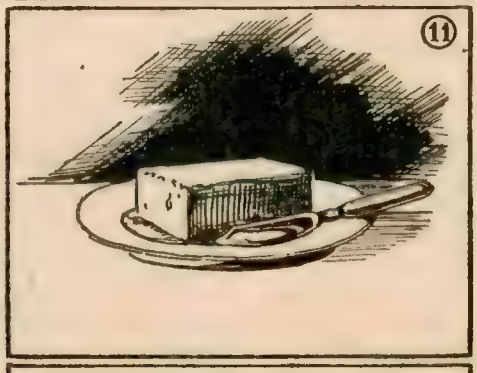

8. Water, boiling, evaporates. Did you know that while gas is burning, water is actually being formed?



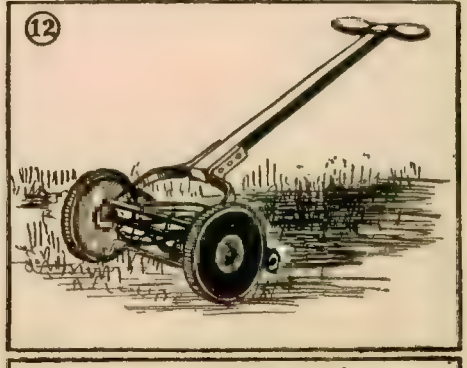

9. Did you know that when cotton is put into ordinary water, heat is actually formed?




10. A quart of ink is not always expensive. How would you go about forming a quart of ink at an expenditure of one cent.




11. Did you know that when butter or fats become rancid they actually lose weight and shrink in size?




12. A lawn mower has quite a few steel parts. These steel parts become black. Do you know the cause?

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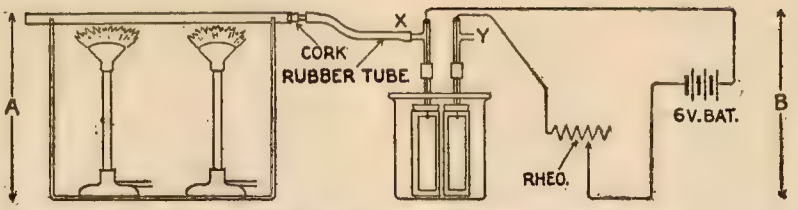
# EXPERIMENTAL CHEMISTRY *and* ELECTRICS

## A Tube "Furnace" and Electro Gas Generator

By RAYMOND B. WAILES

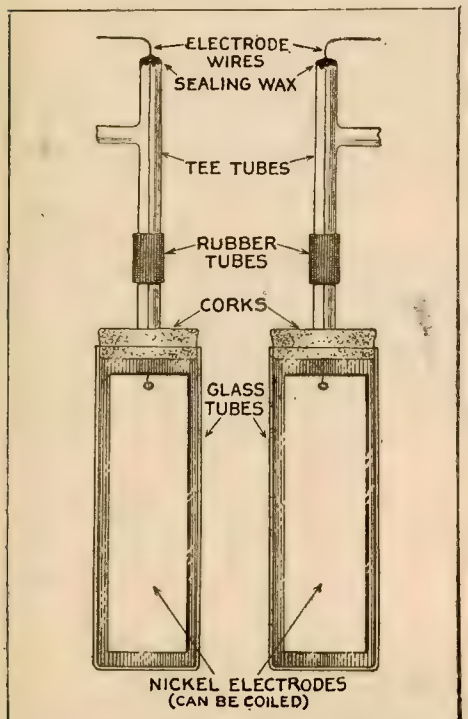
PERHAPS not one in a hundred home laboratories have a tube "furnace" in which oxidation and reduction experiments can be carried out. A short length of pyrex glass tubing of sufficient diameter and two Bunsen burners with flame spreaders make a very good little furnace for many experiments. Oxides can be reduced to their constituents, metals can be oxidized, substances can be fused in a reducing atmosphere, converted into other substances out of contact with the oxygen of the air, etc.—all these chemical operations are possible with the furnace described.

The pyrex tube should be not less than half an inch in inside diameter. It is supported on a stand made of galvanized iron. The stand is made of such dimensions that two Bunsen burners located as shown have the tube in the hottest part of their two flames. V notches cut in the upright ends of the stand keep the tube in place. In heating a substance, it is best to heat it slowly, and to have the substance in the powdered form.

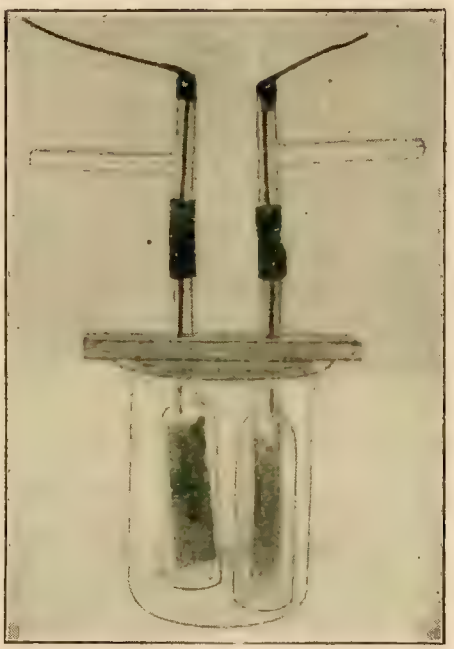



*The above illustration shows the connections for the gas generator described here.*

If iron oxide is wanted for an experiment, it can be made in the little tube furnace by placing metallic iron, such as a few nails or tacks in the tube, heating to redness and passing oxygen gas or even air through the tube. The oxygen oxidizes the red hot iron to form iron oxide. As another experiment, the iron oxide formed can be reduced to metallic iron by heating it in the tube and passing hydrogen gas over it.




*The construction of the apparatus for carrying out oxidation and reduction experiments is clearly shown above. The nickel electrodes can be coiled. The gas passes out through the side arms of the tee tubes. The upper ends of these tubes carry the wires and are hermetically sealed with sealing wax.*



*The above photograph shows the electric gas generator. The beaker is filled with a solution of sodium hydroxide 30% strong for obtaining oxygen and hydrogen by electrolysis.*

To obtain hydrogen and oxygen gas, the experimenter can resort to a home-made electric gas generator. As the photograph shows, this is made from a beaker, two "carbon filter funnels," two tee tubes, and some nickel wire and sheet. The filter funnels are pieces of glass tubing one inch in diameter and four inches long, to one end of which is sealed or connected a two-inch length of glass tubing having a quarter of an inch inside diameter.

The gas is generated on the nickel electrodes placed within the tubes and passes out through the side arms of the tee tubes. The upper ends of the tee tubes are used to carry the nickel wires leading to the nickel plates. They are hermetically sealed with sealing wax. The beaker is filled with a solution of sodium hydroxide of about 30% strength. When a current is applied to the plates, through the nickel wires, hydrogen gas is given off at the negative electrode and oxygen at the positive plate, thus if the tube furnace requires oxygen gas in one experiment, the side arm of the tee tube over the positive electrode should be connected to the tube furnace by means of rubber tubing, and the current turned on; reverse connection gives hydrogen.

A storage battery makes an ideal source of current for this experiment. A heavy duty rheostat should be used in series with the battery to regulate the rate of gas evolution from the nickel plates. Nickel is used with the sodium hydroxide solution, because it is not attacked by the latter. The solution of sodium hydroxide should be poured from the beaker into a bottle and stoppered with a cork, not with a glass stopper, when the electro gas generator is not in use.

The tube furnace should not be packed too tightly with the material under examination or back pressure will prevent gas passing through furnace.

(*To be concluded*)

*A tube furnace made with a length of pyrex glass tubing and two Bunsen burners is shown above. The tube is supported on a stand of galvanized iron and V notches on the upper part of the stand keep the tube in place. In heating a substance in the furnace it is best to do so slowly and to have it in a powdered form.*

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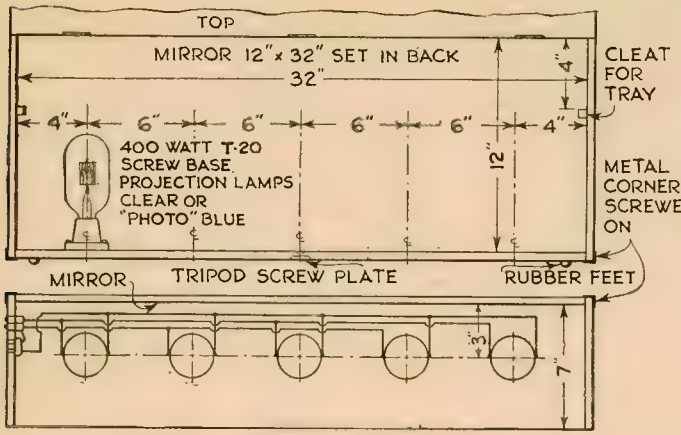


*Fig. 6—The illustration at the left shows a front and a top view of a home made lamp box. Plain mirrors are placed at the back and act as reflectors. Space is provided for five 400 watt projection lamps. A tripod screw plate is provided for mounting the light. Rubber feet are also attached to the case.*

"It is a very easy job. One can be made from almost any old box that is large enough, but I made mine from three-ply veneer wood with metal corners and a half-inch pine base. Here it is (Fig. 5). The top and front swing open as you see and we lift out this tray (Fig. 5-B) which carries our stand, cord, extra lamps and fuses. The lamp box is a little over thirty-two inches long, twelve inches high and seven inches deep (Fig. 6). Those are the inside measurements. The whole secret of the strength of this lamp is this big mirror in the back. I bought it, or rather the piece from which it was cut, from the second-hand furniture store on Second Street.

"It is from an old bureau and one corner was cracked off. I bought it for a song. The bulbs are four hundred watt projection lamps of a size known as T-20. This means that they are twenty-eighths or two and a half inches in diameter. They are wired up in units of two and three. Each unit is connected to one of these toggle switches in the end of the case. By snapping the proper switch I have a choice of two, three, or five lamps. I seldom use all five unless I want to take an outdoors picture at night, then it comes in handy. The side walls and the top are painted with aluminum paint, or have mirrors. That is so the light will spread more, and when the top is tilted up just a bit it gives a more concentrated light that is controllable. While this light may violate a few of the rules laid down by professional lamp designers, it certainly serves its purpose most effectively.

"The lamp sockets are of porcelain and they are placed on six inch centers, that is, six inches apart, measuring from center to center. They are all placed on the same longitudinal line three inches from the face of the mirror. The external connection plug can be either the special connector made by most of the large electrical accessory manufacturers or it may be a heavy male member of any separable plug. The connection cord, which should be about thirty feet long, is number 14 rubber covered and may be waterproof cable with a pin plug at one end for insertion in a baseboard outlet and at the other with the attachment plug for connection to the lamp.

"The wiring in the lamp should be made with asbestos-covered number 14, and the wires are looped from socket to socket, the insulation being stripped away at each connection and the braided wire split over the connection screw and the screw head firmly tightened down over it.

(*Continued on page 997*)

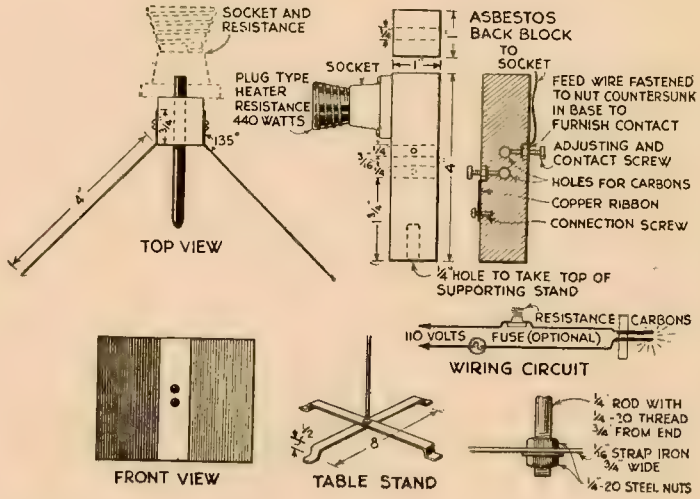


*Fig. 7—At the left is a lighting outfit using carbons for the necessary illumination. Reflectors are mounted on each side of the block. The wiring diagram is also given. A resistance unit rated at 440 watts is placed in series with the line. The arc is struck by touching a third carbon to the points of the two lamp carbons.*

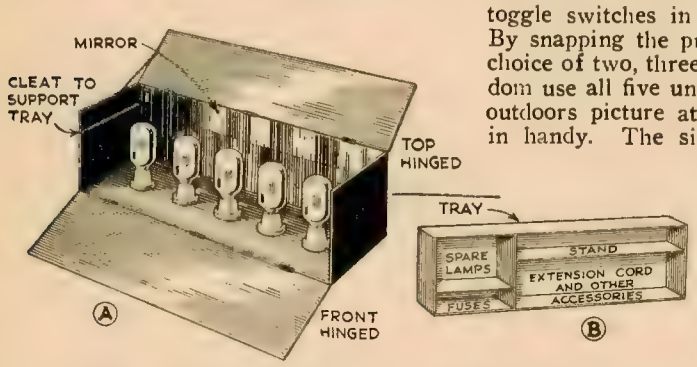


*Fig. 5—The complete home made lighting outfit is shown above at A, and B shows the interior of the tray which provides room for the lamp stand, fuses and other accessories.*

*The 440 watt lamps are connected to a 110 volt circuit as shown above. The connection cord should be about 30 ft. long and of No. 14 rubber covered wire. Water-proof cable may also be used.*

# CAN YOU ANSWER THESE QUESTIONS?

**Form Your Own Answers Before Turning to Page Indicated**

1. What is the latest scientific opinion regarding the control of sex? (See page 906.)
2. Do ships, when they sink, always create a suction whirlpool? (See page 910.)
3. How has electricity been applied in recent experiments, so as to shatter or break up the atom? (See page 913.)
4. How much higher will a suspension bridge be in winter than in summer, due to contraction of the cables? (See page 914.)
5. How does the new "mechanical lung," successfully tried out by the Navy Department, enable men to rise from a sunken submarine?" (See page 916.)
6. What is your theory of the formation of Jupiter's ninth moon? (See page 918.)
7. How much greater is the light-gathering power of a 200-inch diameter telescope mirror, compared to the present largest 100-inch diameter mirror? (See page 920.)
8. Can a brain function, if an animal's head is separated from the body? (See page 923.)
9. Did you know that the latest electric waffle iron indicates automatically when the proper temperature has been reached? (See page 928.)
10. How do so-called "Electric Fish" produce an electric shock? (See page 932.)
11. Do you know the proper methods of lighting a subject when taking home movies? (See page 938.)
12. Can you describe just how to build a cheap, yet powerful reflecting telescope? (See pages 942 and 943.)

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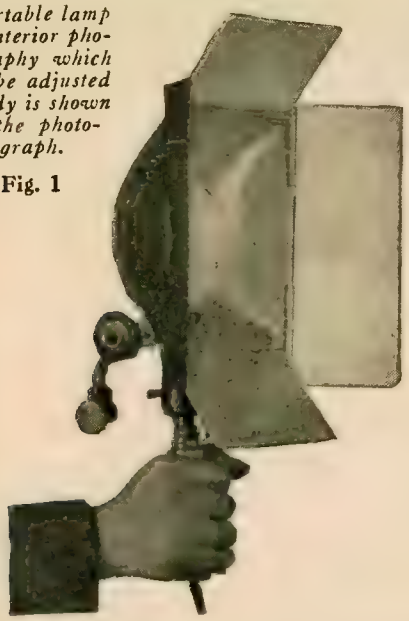


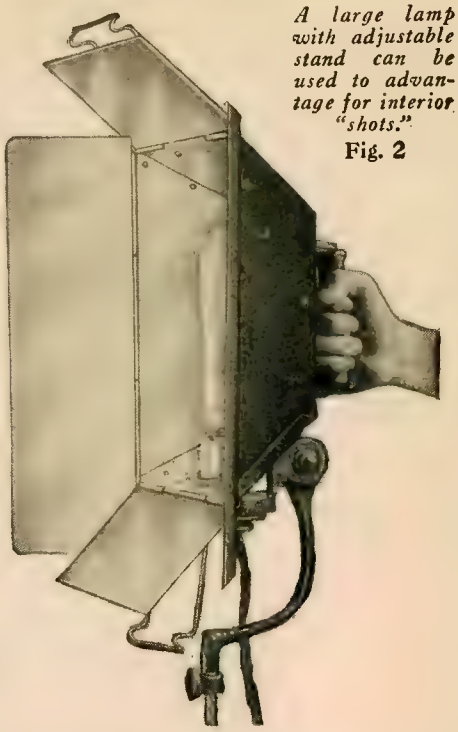
*A portable lamp for interior photography which can be adjusted readily is shown in the photograph.*

**Fig. 1**

# HOME MOVIES

## *Making Movies With Artificial Light*

By DON BENNETT



*A large lamp with adjustable stand can be used to advantage for interior "shots."*

**Fig. 2**

GEORGE BLAKE had decided to try his hand at indoor movie making during the winter months when cold weather and the poor light kept him in the house. Because of the advice given him by Rockland's movie expert he had been able to improve his outdoor films, had titled and edited his animated album, and had even tried developing his own films.

As he entered the store his eye was attracted to a display of incandescent lamps and stands used for indoor portraiture. These lamps looked like saucepans with a hole in them, through which a lamp was attached to a socket. They were made of aluminum and the inside surface was treated so that it served to soften the lamps rays. Provision was made for attaching it to a stand so that it would be self supporting and adjustable to any height. (Fig. 1.) A few larger lamps were also on display, lamps that used a long tubular bulb about two and a half inches in diameter and drawing one thousand watts (Fig. 2).

The movie expert, Jones, walked over and greeted Blake. "These lamps look very nice, Mr. Jones. I have been thinking of taking some pictures indoors and came down for some advice."

"Well, Mr. Blake, indoor movie-making requires very little equipment, as long as you confine your activities to a small area. These little lamps are sufficient, with the aid of a reflector, to illuminate two or three people. If you use your f: 1.8 lens, you can cover more territory of course. Your projection screen makes a good reflector, or you can make one of plain wall-board painted white or aluminum. The reflector should be at least three feet square. It can be made of course on a wooden frame, hinged in the center, and in that way be more easily stored when not in use." (See Fig. 3.)

### *Where to Place Lights*

"How should lamps be placed so as to get the best results?"

"There are several methods of lighting, some productive of special effects, some startling, most of them reproducing the subject as it appears to the eye. The first rule is to have the light stronger on one side than on the other. If the light is even on both sides, (Fig. 4-A), the picture will be *flat,* there will be little detail, no shadows, no relief, just the worst picture the subject ever had taken. If one lamp is used, placed at an angle of about sixty degrees to a line connecting the subject and the camera, one side of the face will be strongly lit, the other side in deep shadow, just a few high spots on the shadow side standing out where the light reaches them. This is also bad, but not quite so poor as flat front lighting. If you place your reflector on the shadow side (Fig. 4-B) the shadows will be lessened but there will still be enough shadow to make the features stand out. If the light is placed in back and to one side of the subject, a reflector near the camera to light the shadow side, we have profiel lighting, in which the face and head is outlined in bright light, while the features are in shadow; slightly relieved by the soft rays from the reflector. (Fig. 4-C.)

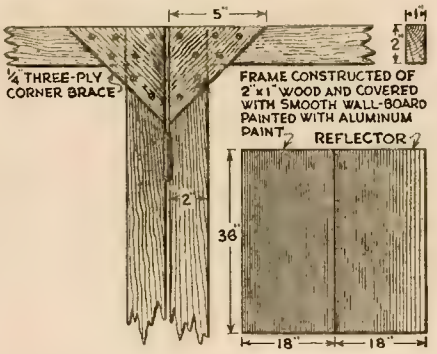



*Fig. 3—Details for the construction of the frame for the reflector are given above. The frame is made of wood covered with wall board.*

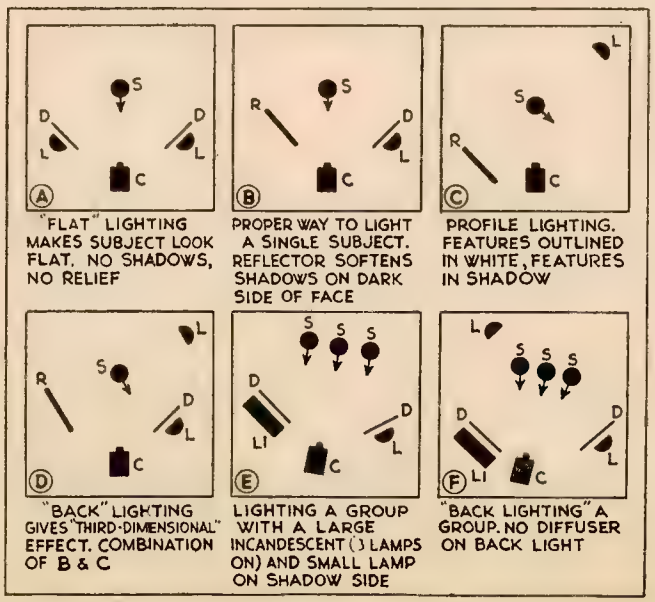

A
"FLAT" LIGHTING MAKES SUBJECT LOOK FLAT. NO SHADOWS, NO RELIEF
B
PROPER WAY TO LIGHT A SINGLE SUBJECT. REFLECTOR SOFTENS SHADOWS ON DARK SIDE OF FACE
C
PROFILE LIGHTING. FEATURES OUTLINED IN WHITE, FEATURES IN SHADOW
D
"BACK" LIGHTING GIVES "THIRD-DIMENSIONAL" EFFECT. COMBINATION OF B & C
E
LIGHTING A GROUP WITH A LARGE INCANDESCENT (3 LAMPS ON) AND SMALL LAMP ON SHADOW SIDE
F
"BACK LIGHTING" A GROUP. NO DIFFUSER ON BACK LIGHT

*Fig. 4—L lamp; L1 incandescent lamp described here; D diffuser; S subject; C camera; R reflector described in text.*

"If another light is added in front on the side of the camera away from the reflector, we have a combination of the second and third positions, (Fig. 4-D) and it gives us a normally lighted subject with a touch of light in back that causes the figure to stand out from the background, sort of a third dimensional effect. All these lamp positions hold true for one or two persons, slight adjustment of the lamp being all that is necessary to illuminate the second person.

### *Building a Powerful Light*

"FOR lighting a group of three or more people, we need more or larger lights. I have just finished making for my own use a portable lamp that uses two thousand watts of current to light five bulbs. Would you like to see it?"

"I certainly would, and if it isn't too hard a job I would like to make one for myself."

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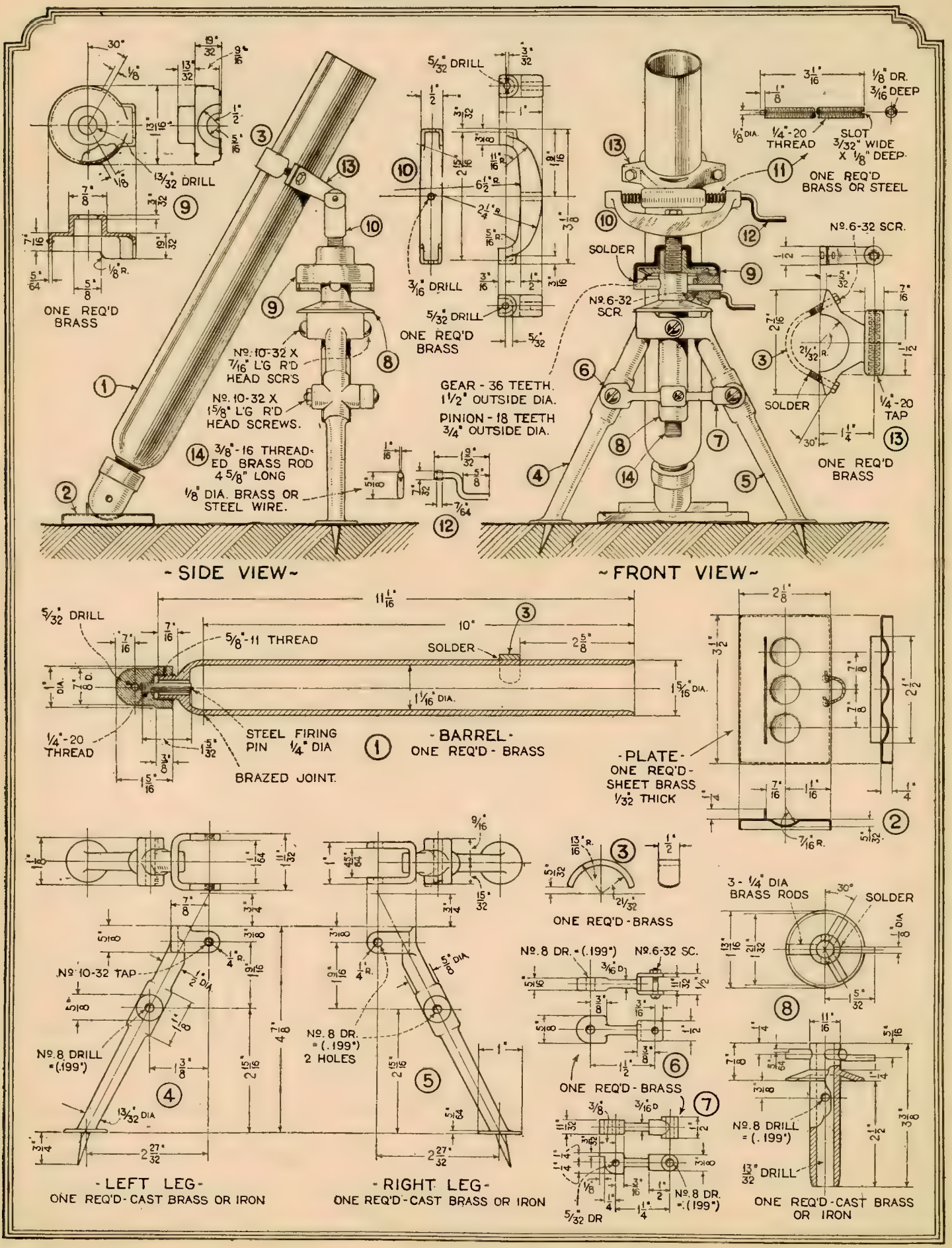
# DETAILS OF PRIZE-WINNING STOKES' MORTAR




*In the diagram above are the full constructional details for building a Stokes' Mortar, similar to the one which won the cup for the present month. While this particular device was largely made from castings, the man handy with tools will find it not at all difficult to cut out the brass with a hacksaw and file it to shape. The construction is simple enough to permit this; a lathe helps greatly.*

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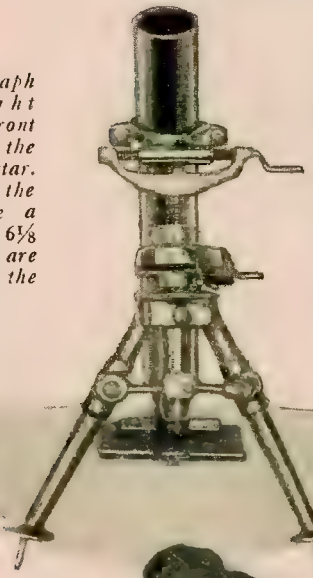
# MODEL DEPARTMENT

## *Model Stokes' Mortar Built by Sgt. W. W. Kane Captures This Month's Trophy Gun Is Exact Replica of That Used by Infantry During the War*

**Trench Mortar, a Perfect Working Model, Eleven Inches High, Is Constructed of Brass and Steel. Took Four Months to Build in Spare Time. Is Made of Scrap Metal. No Lathe Used for Making the Parts.**

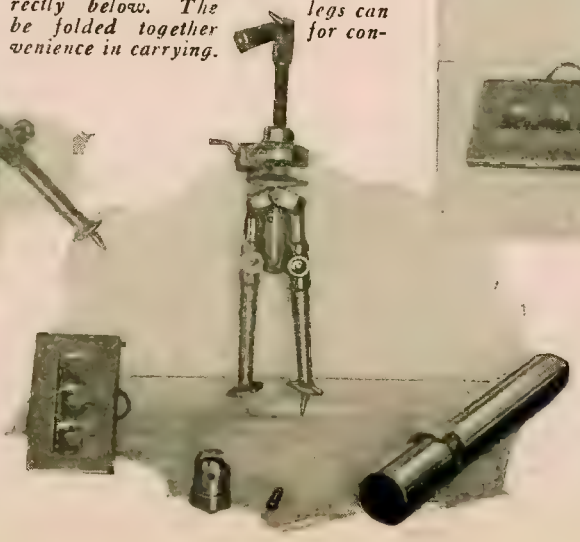
THE trench mortar which won this month's cup was built by Sgt. Walter W. Kane, of the Howitzer Co., 71st Infantry, N. Y. National Guard, in the course of four months' spare time. The model of the three-inch Stokes' mortar actually works and stands about eleven inches high. The barrel is a section of brass water pipe which is nickel plated, three pieces of steel form the base cap and the firing pin is part of a steel bolt. The gear cap, gears, yoke and trunnion standard are all made of brass, while the elevating and transversing screws are portions of steel bolts. The legs of the mount are of cold rolled steel and brass tubing. The legs are of eight separate parts and the cross stays of ten separate parts. The baseplate is of brass. The range of the original mortar, as used in the war, was about 800 yards, and a shell consisting of a case containing the high explosive, smoke material or gas was used. (See rules on page 982.)



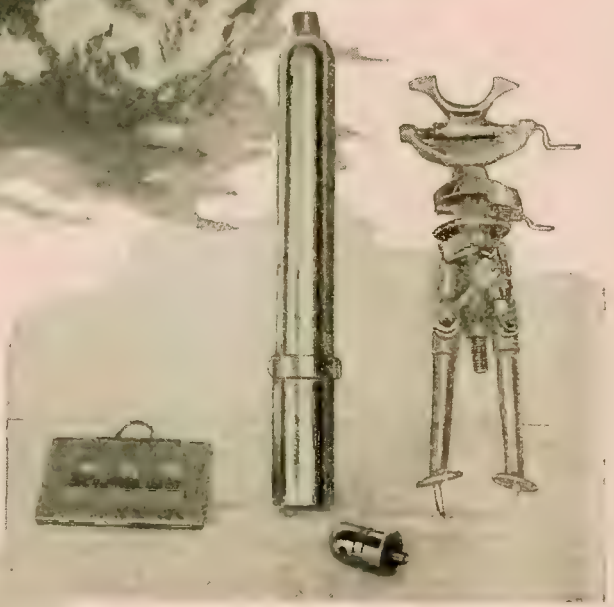
*The photograph at the right shows a front view of the Stokes' mortar. The legs of the mount have a spread of 6⅛ inches and are spiked at the ends.*

*The mortar mounted in a concealed position ready for firing is shown in the illustration. The real 3 inch mortar had a range of 750 yds. and a minimum range of 100 yds.*

*Above is a side view of a model showing the gun set up in firing position. The base cap rests upon the base plate when in use. The transversing handle and the elevating handle may be seen. The yoke, gear cap, gears and trunion standard are all of brass.*



*Below is a photograph showing the parts of the Stokes' mortar. The barrel is at the right, the base cap and firing pin in the foreground. The base plate at the left and the mount is shown directly below. The legs can be folded together for convenience in carrying.*



*The Stokes' mortar is shown above disassembled. The base cap with firing pin in place is shown in the foreground. The base plate is at the left. The guard and rope handle of this plate may be seen. The mount for the mortar is shown at the right. The cross-stays elevating and transversing screws and handles are visible on the barrel mount. The barrel itself is shown just in back of the base cap. This portion of the gun is 10½ inches long and 1¼ inches in diameter.*

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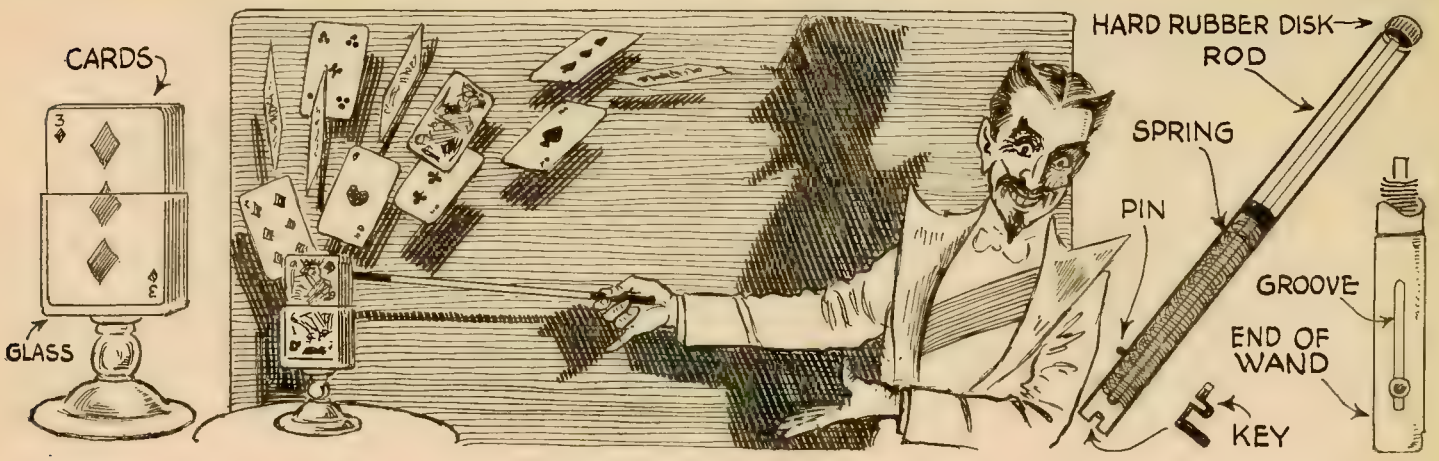



*In this improved rising card effect a deck of cards is placed into the houlette containing a card chosen by the spectator. A rod is lightly touched against the back of the cards and sends them all flying up into the air. The houlette is turned 180°, presenting the back of the cards to the audience and the same action continues. Rotating the houlette again, the magician shows but one card left, which was the one chosen. By way of explanation the diagram above shows what goes on. The wand itself is of a mechanical construction and the spiral spring rotates a disc at the end which when made to lightly touch the cards, pushes them into the air. When it comes to the chosen card, it stops because the duplicate of the one forced is made of metal covered with a card on either side. Its weight makes it too heavy to be lifted by the wheel. Touching the rod to the front drives out all of the other cards.*

# MAGIC

**Tricks for Amateur, Parlor, Lyceum and Professional Entertainer**

*By*

## DUNNINGER

**INTERESTING TRICKS FOR Those Magically Inclined**

**NUMBER SIXTY-SIX OF A SERIES**

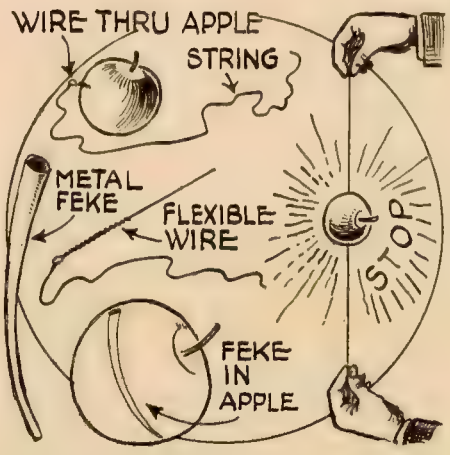
### Second Sight With Crayons

THIS is an absolutely new principle with which the magician presents a pleasing and mysterious experiment in second sight. A box of varied colored crayons and a borrowed derby hat are the only prerequisites. Someone in the audience is requested to select a color. The magician picks out the colored crayon from the box, writes a name on a piece of paper and then asks that that crayon, together with all the others be placed into the borrowed derby hat. He is now blindfolded and, picking out one crayon after the other, he finally calls out the color of the one selected crayon, as if mysteriously gifted with the power to know that this was the same crayon he had previously used. The secret is unusually simple. All crayons are covered with a paper wrapper. After one of the colors has been decided upon, the magician writes with it on a piece of paper and secretly breaks it beneath the paper wrapping. With a little practice, he can easily feel the break of the crayon as he holds it to his forehead. If repeated, the break must be made in a different place.

*In this effect the break beneath the paper wrapper of a colored crayon indicates to the magician which one of the selected crayons he must correctly name. The trick can easily be arranged for.*

### New Obedient Apple

EVERYONE has seen the obedient ball in which a ball is made to slide down a string and mysteriously stop at command. This stunt as well as its operation is very well known, but for someone to pick up an apple and then thread a needle and string through that apple and repeat the same experiment is a much greater puzzle, and the stunt becomes fairly sensational. The operation of the trick is dependent entirely upon a small metal feke in the form of a curved tin tube illustrated in the diagram. This is secretly forced through the center of the fruit at an opportune moment or it may be threaded through the fruit at the time when the magician passes the needle and thread through it. The needle in this case is a flexible steel needle long enough to pass through the fruit and with it the string is threaded through the apple. Any time any of the spectators commands the fruit to stop in its downward fall, the apple does so. Tightening the string produces this effect. Many variations of this trick are, of course, possible to the magician.




*By aid of the metal feke placed into the apple and the string threaded through it, the performer can command the apple to stop midway in its fall. This is an excellent pocket trick.*

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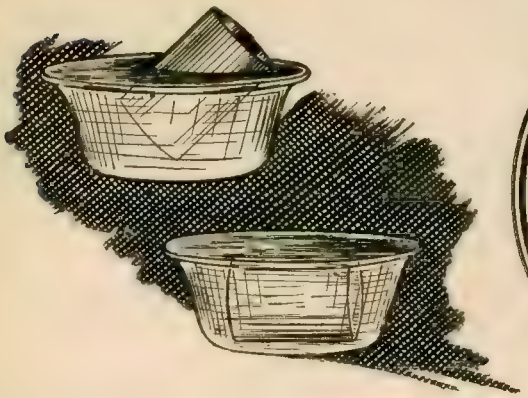
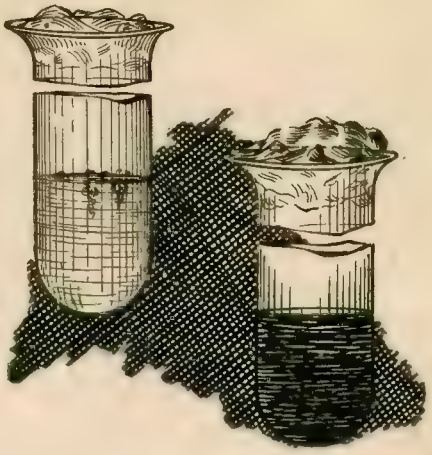


*A metal can floats in a pan of water raising water level to brim. How will level be affected if can is submerged as shown?*

*Is well water warmer or colder than the average temperature of the air at the surface? Is it warmer than the atmosphere in winter?*

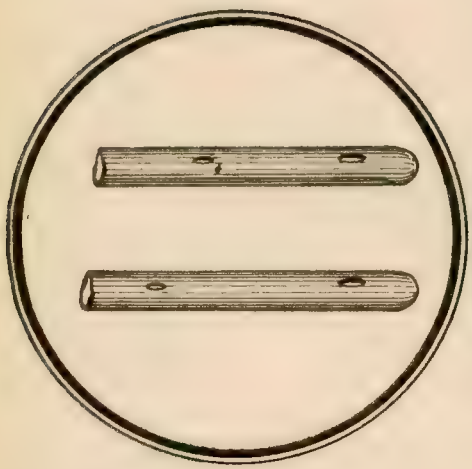


*Bacteria multiply rapidly in dilute sugar solutions. Strong syrup solution is used as a preservative. Can you explain this?*

# Scientific Problems *and* Puzzles

By ERNEST K. CHAPIN, M. A.

***Can you answer these scientific brain teasers? Answers appear on another page.***



*Two flute tubes are identical save that one has a hole a little nearer the end than the other. Can they be brought in tune without alteration?*

*In the game called "hearts" six dice are thrown. Each die is lettered so that the upper faces can spell the name of the game. How frequently will a winning combination occur?*

*A diver has a concave air lens with thin glass walls and uses it under water. Will it magnify or produce the opposite result? Ordinarily, a convex lens magnifies.*

*A fish in a lake observes a boy standing on a wharf almost directly above him. Does the boy appear any larger or smaller to the fish than he would if both were under water?*

*A piano is put in tune with a pipe organ when the temperature is low as illustrated above. What will be the relative pitch of the instruments when the temperature rises?*

*Answers to these problems appear on page 976.*

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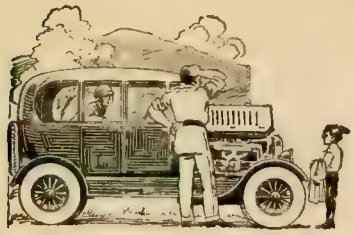
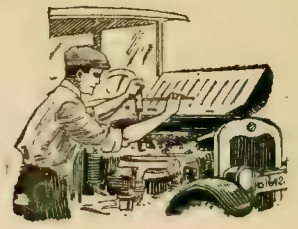


# Motor Hints

*Conducted by*
GEORGE A. LUERS



*Valuable pointers for the car owner to help keep auto in condition*

## Care of Storage Batteries

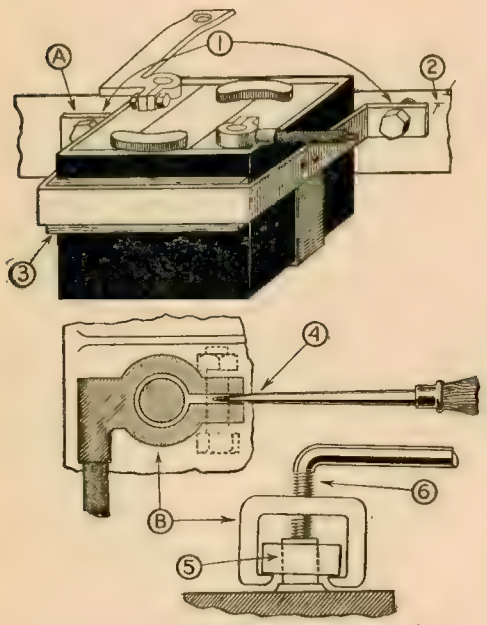
ANY battery left loose in the bracket is certain to break the ground connection and this instantly burns out all lights if switched on.

Batteries are frequently changed and due to the variation in size the bracket will not clamp them tight or the handle type of clamps will not fit.

A means to tighten a loose battery in a bracket is shown in the sketch. This consists of the addition of a wood strip in the bracket and use of bolts to draw the bracket tightly against the battery.

Also in the removal of batteries the terminals are sometimes corroded and most difficult to take off.

This means, shown in the illustration, of using a screw driver to open the terminal after removal of the bolt is recommended. Where the screw is corroded in place, a puller made from a piece of steel, fitted with a jack screw, as shown in the sketch, is a good tool to use.



*The above illustration shows methods of preventing battery troubles. A, illustrates method of securing battery, and B procedure for removing terminals. 1 bolts, 2, space, 3, filler, 4, screw driver, 5, terminal, 6, terminal remover.*

A tool of this type will not damage any battery post, not matter how weak.

If a hammer is used to drive terminals off the posts when corroded, this will do battery post, no matter how weak.
possible fracture of the cell cover, many times the post is broken off the plates.

The battery should last for several years, without more care than to fill with water and correct the charge. If the bracket is loose around the battery, broken cells may result in addition to broken ground connection. Similiar abuse of battery posts in removing terminals will damage completely an otherwise good battery.

## Dash Clamps

A simple, neat and effective means for mounting such accessories, as match box, ash tray, extra switch or extra dash lamp, is with clamps as shown in the attached sketch.

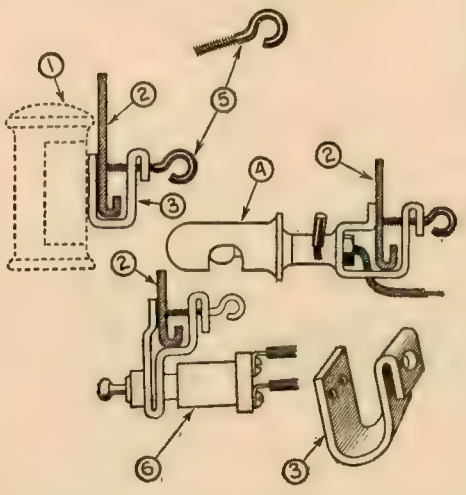
A piece of sheet steel, about an inch wide and three-sixteenths inch thick is used to form a bent clamp. One edge is tapped out for a small screw or eye bolt. The other edge is secured to the accessory with small copper rivets or with a bolt, if provided.

The use of these clamps does not mutilate the dash, as will a large jagged hole. The part is removable, when required, especially any accessory which becomes inoperative and parts for it cannot be obtained.

In making a clamp, the worker will find the steel bends readily if heated red in a gas flame. A bit of black enamel adds a finishing touch.

**DO YOU KNOW—**

**radiators fill solidly with deposits that defy lye, muriatic acid and other solvents if neglected too long. The cheapest form of prevention is to detach the lower hose connection and flow water through the radiator for an hour, at least twice each year. This saves replacing the radiator, which is one of the most expensive parts of the car.**



*Various clamps for dash accessories are shown here. 1, match box or ash tray, 2, dash, 3, metal clamp, 4, dash lamp, 5, screw eye bolt, 6, switch.*

## Ten Rules for Low Pressure Tires

The advantages of the low pressure tires are quickly offset by added cost, if care of these is neglected.

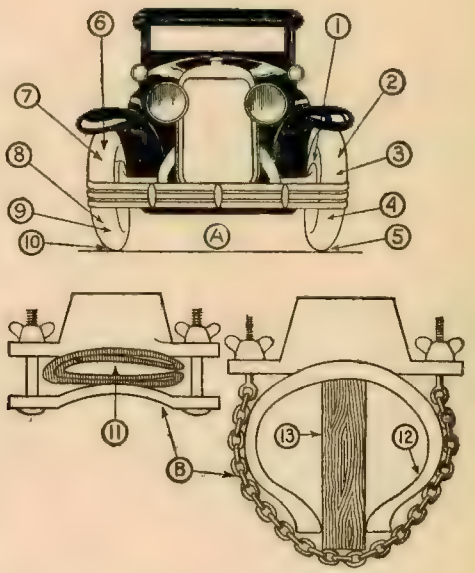
The following ten rules are given as a guide for the owner who would obtain the maximum mileage and avoid frequent punctures and flat tires:

1—Maintain the front tires in alignment and shift the tires around each fifteen hundred miles.

2—Avoid driving in street car tracks. Steel rails of the track not only cut, but the tires are bent enough to cause separation of the rubber from the fabric.

3—Do not scrape the tires against the curb while parking or going out of a parking space. This tends to tear the walls.

4—Avoid road ruts, especially frozen ruts. One long drive through frozen ruts is likely to loosen the rubber on all four tires. (*Continued on page 970*)



*When driving with low pressure tires it is well to follow the above illustrated rules at A. 1, keep brakes evenly adjusted, 2, avoid tight chains, 3, use chains only when necessary, 4, patch cuts, 5, avoid car tracks, 6, maintain pressure, 7, avoid skids, 8, keep out of ruts, 9, do not scrape curbs, 10, align front wheels. 11, tube doubled over to fit in small vulcanizer shown at B, 12, tire, and 13, wooden block.*

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*Above—Marcusenius longianalis, the electric fish*

# ALL ABOUT Electric Fish

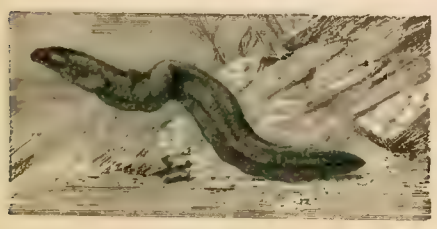
By E. BADE, Ph. D.

**Little known denizens of the deep are gifted by nature to shock their prey. Small animals are paralyzed instantly. The most powerful electric shock is produced by a South American eel.**

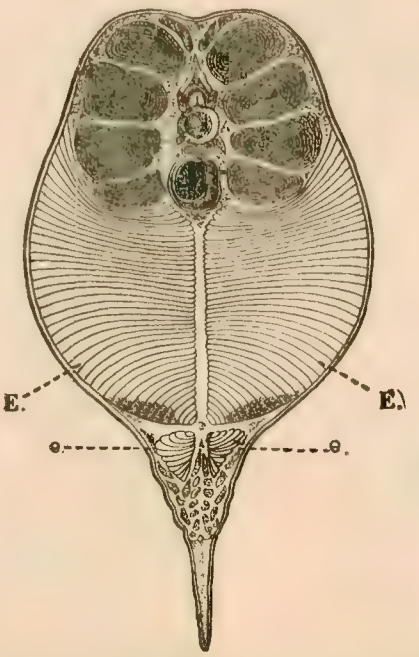
### Strange Fish Which Create Potentials as High as 300 Volts

THE cell, the building block of all life, contains within its walls a drop of fluid. It is within this drop that chemical changes and the transferring of materials takes place. Here an electric current is generated as soon as a number of chemical processes are going on at one time having different end reactions. Simple and definite reactions are probably never found in a single cell, especially a reaction of a single character, all are more or less complex, and accordingly an electric current is always generated. This has been definitely proven. An electric current is always found within the living cell. Naturally special apparatus is needed to detect the current and for this purpose the Einthoven galvanometer is used. In this instrument a fine silvered quartz thread is stretched or supported between the poles of an electromagnet. If a current passes through the thread, the magnetic field deflects it. If the current is an alternating or pulsatory current the thread gives oscillations corresponding to the changes. These oscillations are so minute that they are observed through a telescope, or are projected magnified on a photographic film or plate which is moved across the field of view. The strength of the current is calculated from the developed image. A current of electricity sufficiently strong to be noticed without apparatus is only produced by the so-called "electric fish," a comparatively small number of types being known, but even here the individual strength of the current and shock producing potential generated vary greatly among them.

The fish that belong to this class are members of different families and orders and so the organs producing this electricity must have been specially developed in each case. In spite of the divergence of species, the foundation upon which these organs are based, are all similar, one to the other. They arise from the skeleton muscles and in build they resemble six-sided prisms, which are closely pressed together. In shape each prism



*The electric eel which produces a powerful shock is a native of South America. This fish attains a length of four feet. Four-fifths of the body are taken up by the generating plant.*




*Above is the Gymnotus electricus. E are the large electric organs, and e are the small electric organs. This is a cross section behind the head.*

### Tiny Generating Plants Produce Electric Discharges.

may be likened to a battery or pile consisting of alternate layers of different materials, in this case they are cell-like plates the contents of which are alternately filled with cell protoplasm and a gelatinous mass. The cells with the protoplasm are the electric cells and these are modified muscle fibres which are united to nerve fibres. When the nerves are stimulated, the accumulated electric charge is given off. The nerves lead to the brain or the spinal column and the discharge is regulated through impulses from this central organ.

The low potential produced in the ordinary cell is of the same character as the high potential produced by the electric fish. The fish have developed a generating plant for the purpose of protection against enemies and for shocking their prey, thus making it more easily available for them.

Each muscle is, in itself, a tiny generating plant, but here, in these fish, the skeleton muscles have been modified and developed for the single purpose of producing the electric discharge. The modification of the muscle fibres takes place as early as in the embryo stage. The muscle fibre thickens at its base and elongates. The tip of the fibre degenerates and forms a plate, countless number of which make up the entire organ. The electric impulse developed by one plate of the torpedo is not much larger than the potential developed by a strong muscle and is equivalent to 5/100 of a volt. Through the union of thousands of these modified muscles in circuit, the torpedo is enabled to produce a discharge of electricity varying from 30 to 80 volts.

In the north African species of *Mormyrus,* a peculiarly shaped fish, the electric organ is found in the tail region and it is so poorly developed that only a weak shock is given off. Here the segmented electric organs are placed between the segmented muscles. The striated muscle-bundles are still visible within the electric organ. Usually about 8 volts is generated, at (*Continued on page* 964)

*The tail region of the Mormyrus cyprinoides showing the electric organs is illustrated above. This organ, however, is so poorly developed that the fish can only give a weak shock producing from 8 to 15 volts.*

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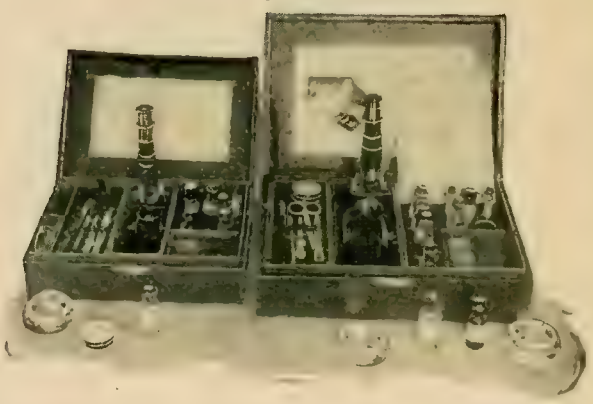
# Invades Land

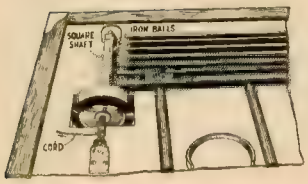
Electricity plays an important part in this year's stock of toys. Chemistry sets and magnetic games also provide much amusement for the children.

### Microscopic Instructor



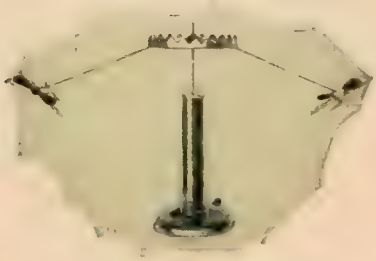
*The two sets here shown instruct the student in the making of and examination of slides for microscopic work. The manipulation is both interesting and instructive.*

### Horse Race



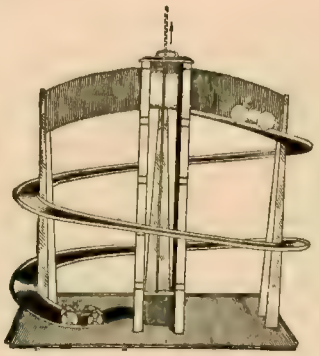

*This horse race is operated by steel balls which strike the slides on which the horses rest.*

### Airplane Swing



*A manually operated ten cent novelty.*

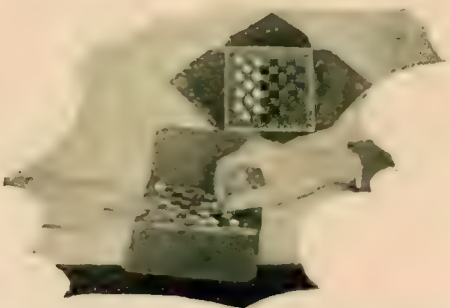
### Gravity Coaster



*Here is a novelty which even a two-year-old can manipulate. This is the great advantage in gravity-operated toys for children in that the youngster can set the toy in motion without parental aid. The elevator-like compartment raises a four-wheel car to the top, whence it runs down the spiral by gravity.*

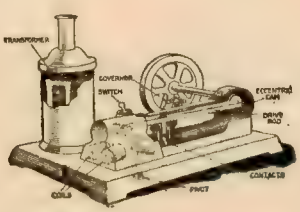
### Magnetic Checkerboard

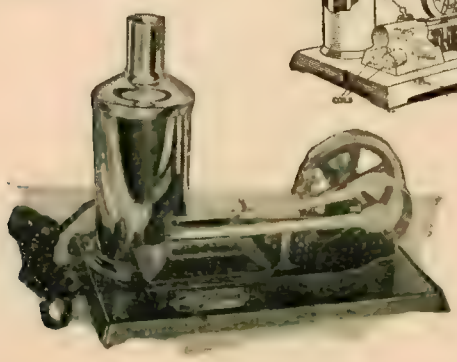
*When the cord is pulled, the fly wheel and the square shaft are caused to rotate rapidly. The balls are driven up the incline when struck by the corners of the rotating shaft. A different horse wins each time and the winner throws a flag.*



*The checkers on these checkerboards are made of round pieces of steel, magnetized and suitably enameled. They adhere firmly to the metal board.*

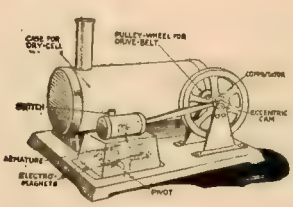
### Electro-Magnetic Engine

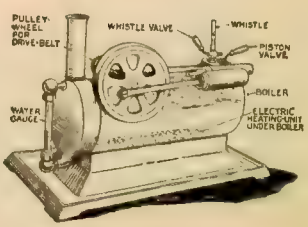


*The photograph and the diagram above shows a new electro-magnetic engine which operates directly from the A.C. power lines. A transformer in the imitation boiler supplies the current to 2 sets of electro-magnets through contacts operated by an eccentric cam and shaft. The armature lies between the magnets.*

### Magnetic and Steam Engine




*The engine at the left in the above photo and diagram is operated by a dry cell, its construction being simpler, yet similar to that of the other engine to the left. The engine on the right operates directly from the lighting circuit, an electric heating unit in the base supplying the heat for producing the steam.*

*Names and addresses of manufacturers on request.*

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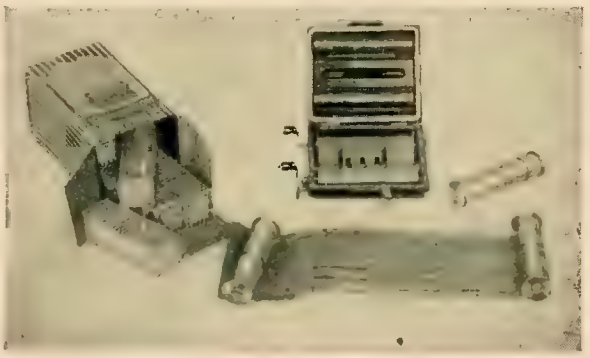
# Science Toy

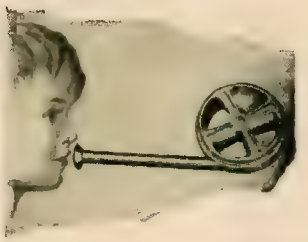
**Latest playthings made possible through the aid of science. Working models of airplanes and other various motorized toys are pictured here.**

### Music Roll Harmonica

*The photograph above shows Lowell Sherman and Gwen Lee, famous motion picture stars. Mr. Sherman is grinding out a tune on the music roll harmonica which, judging by Miss Lee's look, is thrilling her immensely. The photograph at the right shows one of these harmonicas opened up, with an extra music roll in the foreground illustrating the slits in the roll through which air passes. The two cranks for playing and rewinding are on the side of the harmonica.*



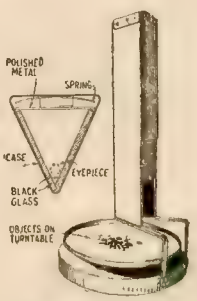
### Air Turbine



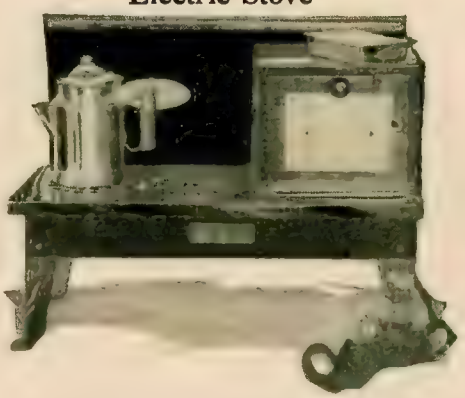
*A simple air turbine combined with a whistle made of celluloid. The ball spins around rapidly when the toy is blown into.*

### An Art Aid

*The photograph and diagram here shows a modern adaptation of the Kaleidoscope. Bits of colored paper and metal are placed on the turn table and are viewed as geometrical designs.*




### Electric Stove

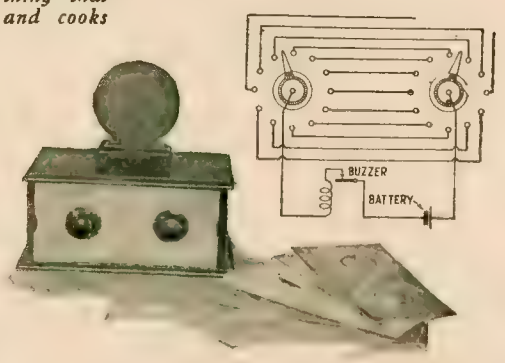


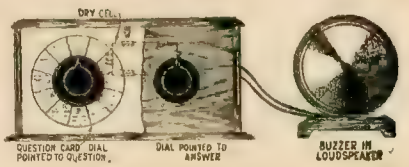
*This illustration shows an electric stove of a smaller size than the one indicated in the previous issue. It will do anything that mother's stove does. It bakes and cooks electrically.*

### Airplane

*This plane actually flies. Because of its construction, it is almost impossible to wreck it, even when it accidentally hits a tree.*

### Educational Toy

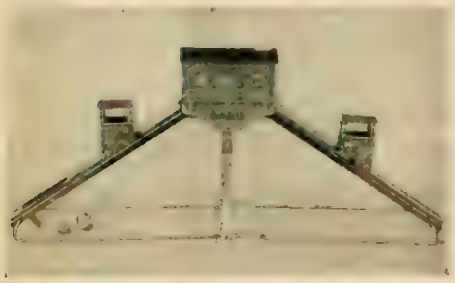


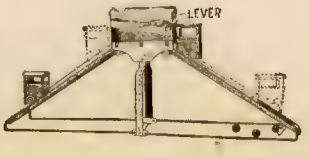

*This toy is made very similar to a small radio set with a cone loud speaker. A card is placed over the dials. To the left are questions, to the right are the answers. When the dial on the left-hand side is turned to one question, the right-hand dial must be rotated to the correct answer before a buzzer in the loud speaker will sound. Many questions are found on the different cards. Diagram above shows construction and circuit.*

**It was impossible to include all the new toys in the previous issue. Toys are in season all year; hence, the new scientific ones are here continued.**

### Gravity Railway



*The cars oscillate back and forth and are operated by balls. Each ball is released by a trip mechanism at the top and dropped from the bottom of one car at the end of the run. The other car is weighted.*

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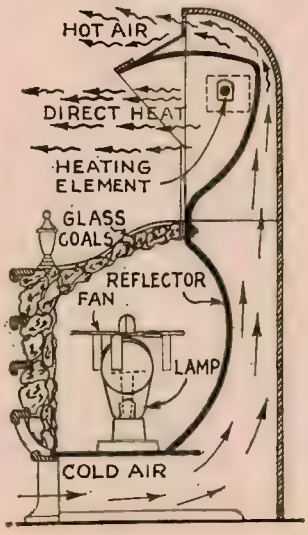
# SHOWN AT ELECTRIC SHOW

### Fireplace Heater

*The above photo shows a new electric heater to be placed in the fireplace. It can be installed easily and when in use appears similar to a real fire. The heating unit is concealed under the hood of the grate. A fan rotated by the heat from a lamp as shown produces the flicker of an actual fire.*

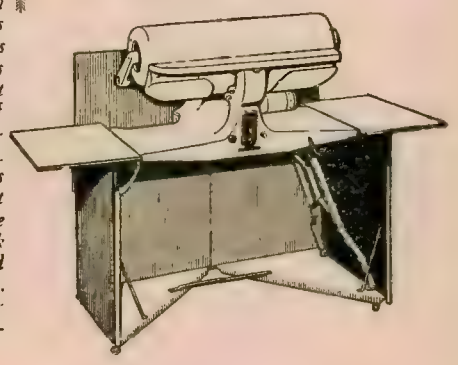
*The illustration below shows a sectional view of the electric fireplace grate and heater. Arrows indicate air circulation.*



### Clothes Washer

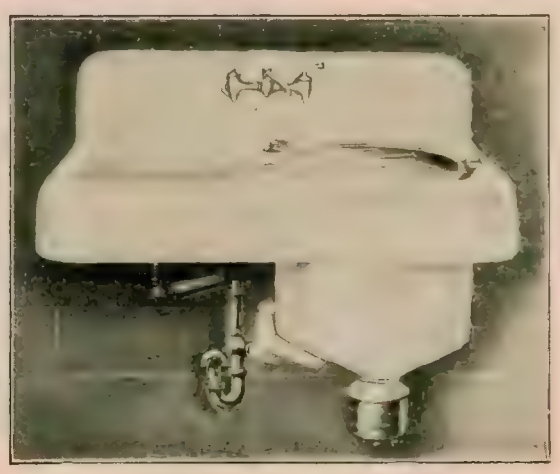
*A small washer which weighs only 20 pounds is shown above. It is ideal for apartments as it can be kept almost any place. Rustproof metal is used throughout in its construction. A clothes wringer is mounted on one end. It can be placed on the drain board of a sink or on the table and costs little to operate. An oscillating cylinder washes the clothes thoroughly.*

### Electric Ironer



### Electric Dish Washer-Sink

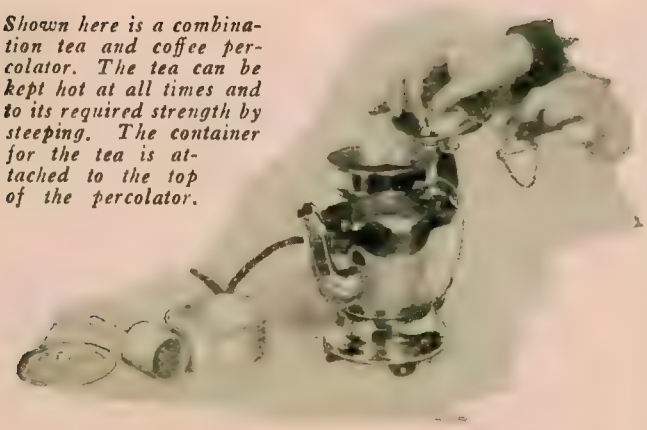
*At the extreme right is a combination electric dish washer and sink. Just to the right is an illustration showing how the water is forced up against the dishes in the compartment. The motor and propeller for throwing the water upward are housed in the small case at the bottom of the washer. Only three and a half quarts of water are used during the washing. The manufacturer makes several types of dish washers and dish-washer-sink combinations.*



*The above illustration shows a small ironer for apartment house use which can be folded when not in use. It can thus be placed in an out of the way position. The heating unit is carried in a trough just beneath the roller while the roller itself is turned by an electric motor. Old types of ironers and mangles carry the heating unit within the roller.*

### Tea-Coffee Percolator

*Shown here is a combination tea and coffee percolator. The tea can be kept hot at all times and to its required strength by steeping. The container for the tea is attached to the top of the percolator.*



### Automatic Toaster

*The illustration at the right shows an automatic toaster which toasts two sides of two slices of bread at the same time. It opens automatically when the bread is toasted but does not turn the current off because the heating elements open far enough to keep the toast warm for five minutes without burning. The toasting time ranges from two minutes to forty seconds as the temperature of the heating elements rises. This toaster does twice the amount of work of the ordinary type and yet only consumes 660 watts.*

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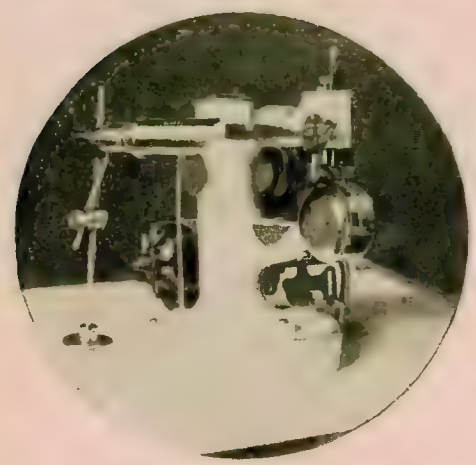
# LABOR SAVERS NEW YORK



*The above photograph shows the hosiery knitting machine in use, and at the right is a view of the machine showing the drum over which the stocking is placed.*

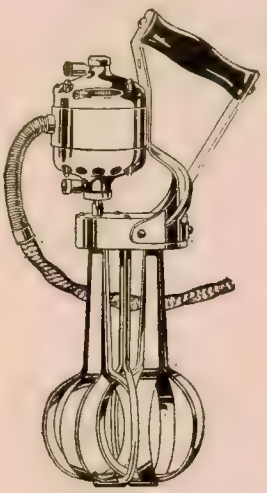
### Hosiery Knitter

*A machine for knitting holes and repairing runs in stockings so that they cannot be detected is shown here. For repairing holes thread is used but the machine needle picks up the broken silk threads in a run and loops them back into the original fabric making the stocking like new again.*

### Paint Sprayer

*The illustration below shows a paint sprayer which is attached to the vacuum cleaner. It comes complete with three containers, three tips and two nozzles. Brushing lacquers and paints of light consistency are easily applied. Motor driven sprayers are available for commercial work.*

*The illustration below shows the electric mixer with removable motor and eight blade double acting beaters. The motor speed is variable.*



### Tie Presser

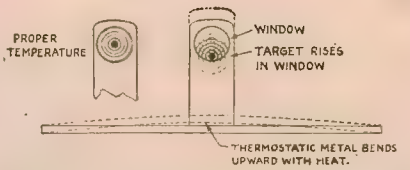
### Electric Beater

*An electric beater for the household was one of the novel devices at the show. It is equipped with a removable motor for cleaning as shown above. The mixer is easily handled as it weighs only 3½ lbs.*

*A neckwear presser is shown at the left both in open and closed positions. A metal form fits into the tie so that seams do not show through after pressing. The lining is pressed at the same time. The pad provided is moistened and presses against the tie when the device is closed. A heating unit is placed in one side of the case.*

### Waffle Iron With Heat Indicator

*At the right is a photograph of a waffle iron equipped with a heat indicator which tells the proper baking temperature, thus eliminating all guesswork.*




*The above illustration shows how the heat indicator works. A small target is raised by a thermostatic strip which bends upward as the heat increases. When the red target ball completely covers the window, the grids have reached a temperature of 450 degrees F., the proper waffle baking temperature.*

*Names of manufacturers furnished upon request.*

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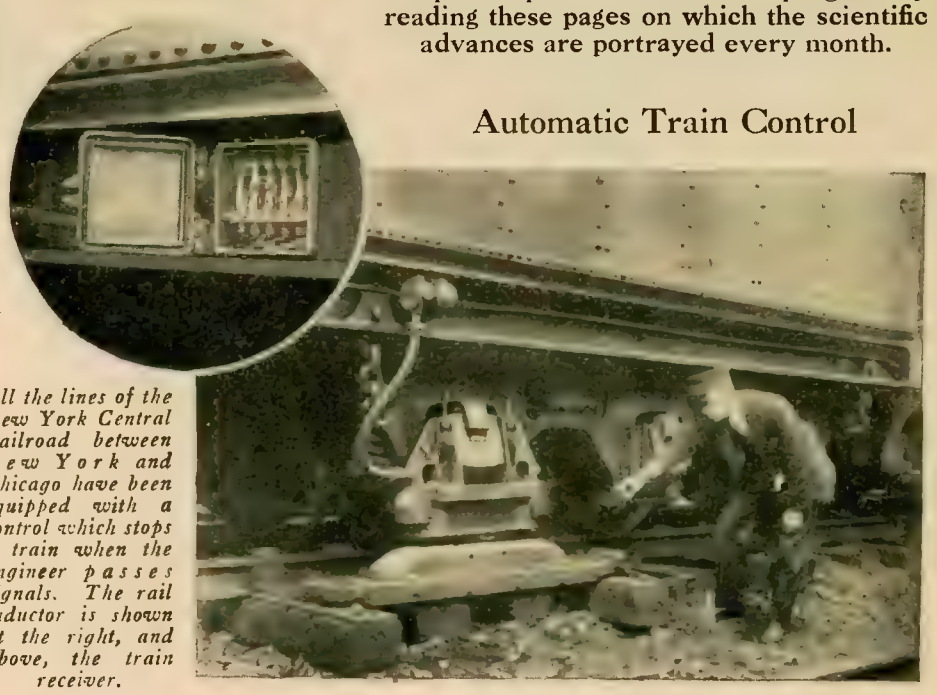
# Progress

*ation of the Latest and Inventions*

**Keep in step with the march of progress by reading these pages on which the scientific advances are portrayed every month.**

**An automatic train control, color films by new method, a submarine rescue boat, a rubber suit, a pancake machine, an outfit for X-raying trees and poles and a tug which crossed the Atlantic.**

## Automatic Train Control

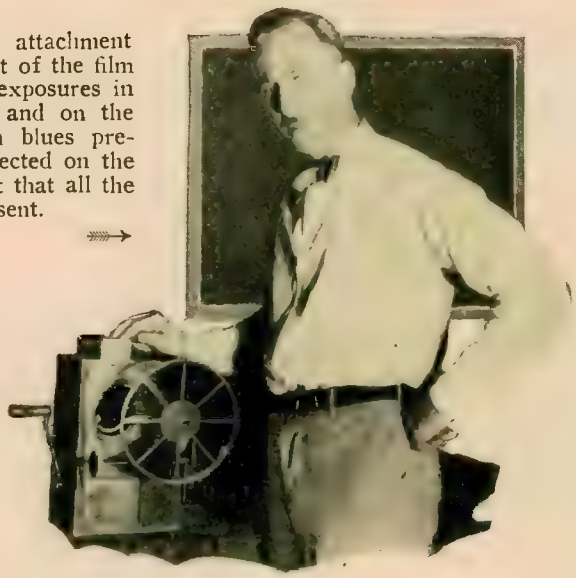


*All the lines of the New York Central Railroad between New York and Chicago have been equipped with a control which stops a train when the engineer passes signals. The rail inductor is shown at the right, and above, the train receiver.*

A NEW automatic train control system takes the human element out of train operation to a great extent and prevents disaster, even though the engineer should pass a danger signal or become incapacitated at his post. The device consists of electric coils or inductors placed at intervals along the rails and a receiver which is attached to the lower portion of the tender of all locomotives. Each inductor is connected to the signal system nearest to it, and if the danger signal is picked up by the receiver on the locomotive as it passes over the inductor, the air brakes will automatically be thrown on and sand dropped on the rails. After a train has been stopped by the automatic device, it cannot be started again until the inductors within the block are manually reset.

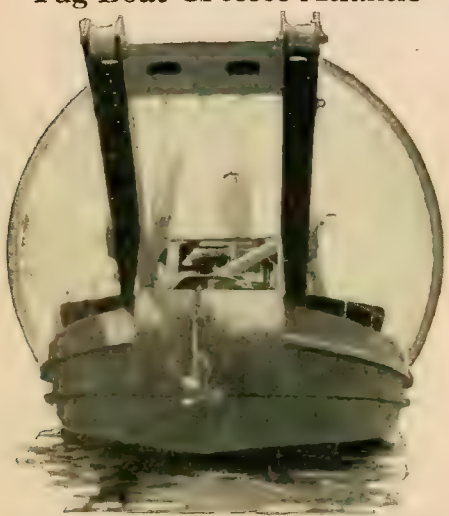
## Colored Movies

A COLORED disc attachment revolving in front of the film registers on alternate exposures in which reds are basic and on the other colors in which blues predominate. These projected on the screen alternate so fast that all the colors appear to be present.



*The photograph at the right shows Frederick T. O'Grady of Newark, with a new color movie machine which uses a disc of multi-colored gelatin. The disc revolves in front of the film. The system is said to be practical for home use.*

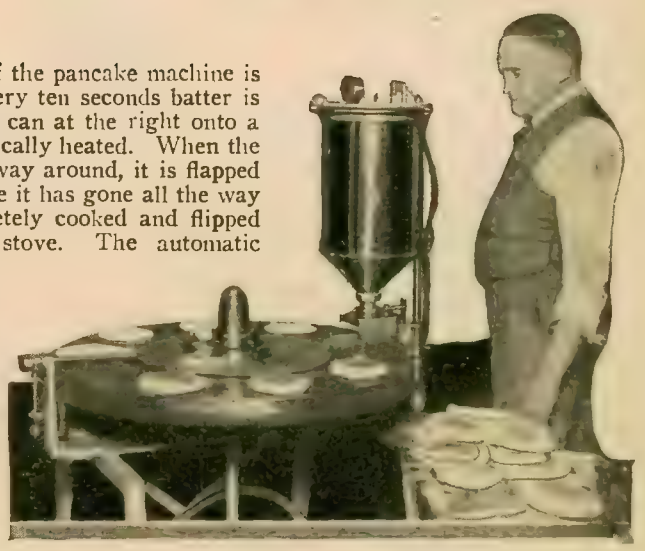
## Tug Boat Crosses Atlantic



*The above photo shows the salvage tug "Standfast" after she arrived from Scotland on a trip which took twenty-five days. The boat will be used for salvaging sunken ships in New York Harbor.*

## Pancake Machine

THE operation of the pancake machine is as follows: Every ten seconds batter is forced out from the can at the right onto a revolving pan electrically heated. When the cake has gone half-way around, it is flapped over, and by the time it has gone all the way around, it is completely cooked and flipped off the turn-table stove. The automatic turner for the pancakes may be seen at the left-hand side of the turn-table just about to turn one of the flapjacks.



*An automatic pancake machine which turns out 380 flapjacks an hour has been invented by Messrs. Coleman and Lamprecht and is shown above. Every ten seconds enough batter for a cake is squirted out. The device is ideal for large hotels and restaurants or for the Army and Navy.*

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# Scientific

## *A Photographic Picturiz- Scientific Discoveries*

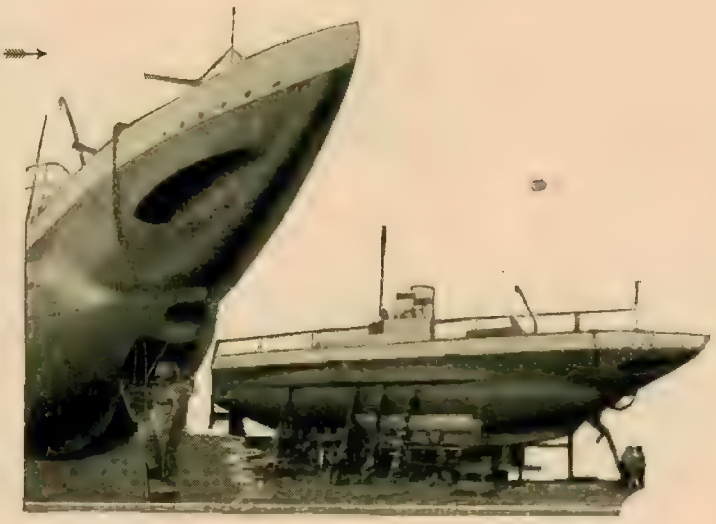
**Interesting highlights in various scientific fields of endeavor mark another revolution in the wheel of progress.**

### Rubber Suit

*The photograph at the left shows a suit made entirely of rubber, which enables the wearer to walk in deep water. Successful tests were made by the Berlin Fire Brigade. Two paddles are provided.*

### Submarine Rescue Boat

A SALVAGE boat for submarine craft has been built by Simon Lake, who has turned a 1906 submarine into a rescue craft for undersea boats. The feature of its construction is a diving compartment in the bow below the water line which permits divers to do rescue or salvage work with their base of operation right alongside of the sunken vessel. Air under pressure is maintained in the diving chamber, so that the divers may enter and leave at will. The Navy Department is cooperating with the designer of the boat. The craft is only 97 ft. long and 11 ft. wide and is capable of descending to a depth of 250 ft. The photograph at the right shows the tiny submarine in drydock and a close-up view of the forward diving compartment. The newest rescue and salvage devices, including the Navy Department "lung" and electric torch have been included in the rescue boat equipment. If such a salvage boat had been available when the S-51 and S-4 United States submarines sank, it is entirely possible that the tragic and needless loss of life could have been averted, by quickly freeing the men imprisoned within the hull of the doomed boats.



*A salvage craft for submarines designed by Simon Lake, of Bridgeport, Con. is shown at the left. A diving compartment is placed in the bow and is supplied with air under pressure so that the men may enter and leave at will. In addition, the boat will be equipped with every known rescue and salvage device.*

### Spikes Stop Autos

*Recently, at White City Speedway, in England, an invention was tried out before police and traffic officials. This was a portable spiked mat which folds into a metal case and also comprises a warning sign. A motor car with all its tires badly punctured is shown above. The device will be used for stopping motor bandits.*

### X-raying Trees

*The utilization of X-rays for detecting defects in standing trees has been made possible by apparatus perfected by the Eastman-Kodak Company. Wire bearing poles have also been studied with the new outfit and imperfections within the pole or tree revealed. The above photo shows a pole being X-rayed.—N. C. McLoud.*

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# Advances

## *Man's Conquest of the Air Still Continues*

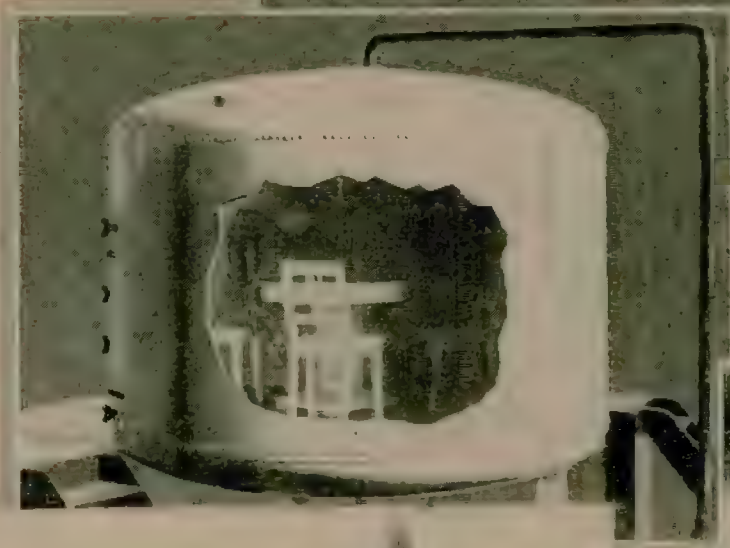
### Models Indicate the Type of Craft We May Expect Soon. Testing Laboratories Determine Best Design

A DEVICE for transferring mail to speeding planes, a vacuum tank giving conditions similar to those found at a height of 1400 meters, the latest dirigible shown in model form which is to carry 200 passengers, a new rocket plane and a remarkable photograph taken from an airplane showing the top of the Woolworth Building thrusting upward through a gap in the clouds shown on this page.

*Above — an invention for taking mail into speeding planes. A cable suspended from the plane travels along the ground into this device and catches a mail sack which is brought up to the plane by turning the cable drum.*

*At the left is a model of a huge airship to be constructed in Germany, and known as the L. Ro. 1. It will accommodate 200 passengers and is expected to journey from Berlin to New York in 36 hours.*

*The photo at the right shows a partial vacuum tank containing a table and chairs, in which atmospheric conditions such as those encountered by aviators flying at great heights can be duplicated. This is a German invention.*



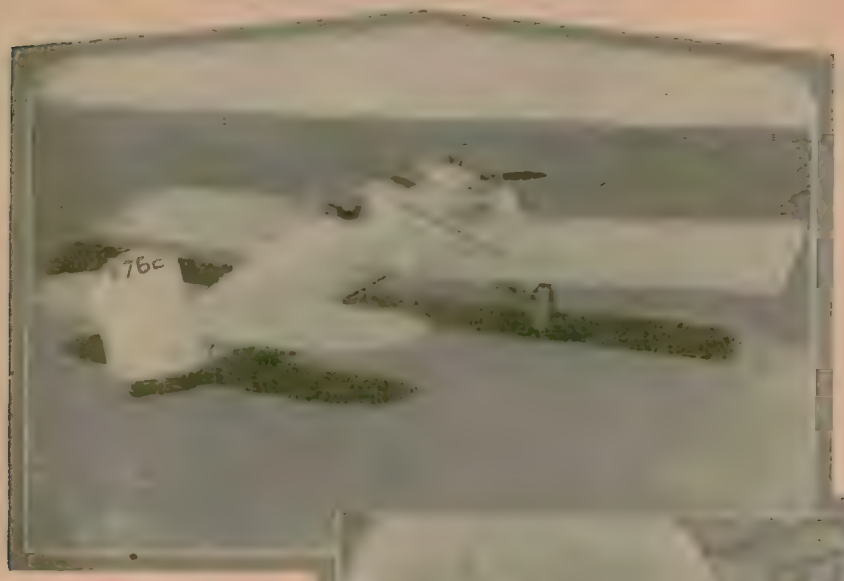
*A most impressive and extraordinary photograph taken from an airplane showing the pinnacle of the Woolworth Building appearing through a gap in the clouds has been reproduced below. The view was taken during a heavy fog which hung low over the city. It will be noted that there are no other buildings seen through the mist, although there are several other tall structures nearby.*

*A model of a rocket plane equipped with 86 rocket gun barrels for propulsion has been made by Maurice Poirier, of Burbank, California, and is shown above.*

# Aviation

## *Newest Developments in the Art of Flying*

**Shown Here Are Many Developments Which Insure Safer and More Rapid Air Transportation**



*A new low-wing monoplane is shown above. A second wing, one-half the size of the forward one, is placed at the rear and acts as an elevator. The plane has a wing spread of 27 ft. and a radical change has been made by eliminating the stabilizer. It can stop within a distance of 150 ft. W. L. Schult and Donald Hall, of the Mahoney Aircraft Corp. in San Diego, Cal., are the designers.*

A NEW type low wing monoplane which can stop within 150 feet, wind tunnel for testing propellers and models of airplanes and an airplane beacon recently installed on tep of the Hotel Beacon, in New York City, are shown here and a complete description given. These latest adjuncts to aviation will further aid air travel of all types.

*The photograph above shows a propeller ready for testing in a wind tunnel. A motor drives the propeller in a wind stream and by various instruments its effectiveness with and without an airplane model is determined. An airplane model used with testing propellers in wind tunnels is shown on the right. Note the supporting cables and portion of wind tunnel which appears at the extreme right hand side of the photo.*

*A 1 200,000,000 candlepower light shown at the left has been installed as an airplane beacon on top of the Hotel Beacon, Broadway and 75th St., New York City.*

←

→

*The new light on top of the Times Square Building, in New York City, may be seen at the right. It is visible within a radius of 100 miles and the beacon can be flashed for sending messages to airmen at night.*

the substitute for the blood had to be found if such substitute were to be used. The second was of a physical and a technical nature in the designing of the necessary apparatus, and the third, surgical and physiological.

The Russian scientists found that a chemical injected into the blood of an animal would prevent the blood from coagulating. This solved two problems at one time; they could use the blood of the animal as the solution, and they could maintain all physiological conditions because nothing had been materially disturbed.

The work then took on the form of producing the artificial heart, which finally resolved itself into a large glass reservoir into which a predetermined quantity of blood treated to prevent coagulation was constantly poured. The pressure for causing the flow of this blood through the arteries and minute capillaries was a constant one, not surging as in the case of the normal arterial circulation. This was obtained by a pure gravity feed, the glass tank being above the level of the severed head. Of course, the blood was oxygenated.

### *The Operation*

WHILE a description of the operation might seem offhand to be gruesome and even quite inhuman, one must remember that most of our modern researches along the lines of medicine and pharmacology have been based upon experiments conducted in the animal kingdom. Guinea pigs, rats, mice, and smaller, as well as larger animals, have been tested for susceptibility to poisons as well as for determining the curative properties of drugs. Were it not for science's dependence upon animal experimentation, we today would probably not have one of our greatest boons to mankind, namely, anesthesia, we would not know much about the internal secreting glands and countless pharmaceutical products as well as their physiological reactions.

These facts are here pointed out to give the reader the correct inferences for the cause of such research. In the epoch-marking work of the Russian doctors, the operation consisted of properly anesthetizing an animal and then proceeding with careful and progressive amputation of the head. All blood vessels were promptly ligated and as soon as possible, circulation was established through the major blood vessels of the neck before the dissection proceeded further. In order to maintain perfect anesthesia, the anesthetic had to be increased as the operation proceeded, because much of the blood passing to the brain was no longer capable of producing a narcotic effect. During the operation, it was perfectly possible to see that life was at no time extinct. Touching the eyelids caused them to react.

About 20 or 30 minutes after the operation was completed, the head gradually came back to life, the same as in a normal animal. The eyes opened and blinked, and presented every appearance of a living pair of eyes. The head itself physically reacted whenever the whiskers, nose, lip or parts of the snout were touched. Marked irritation caused violent movements of such force that sometimes it was difficult to hold the head on the plate. On occasion the mouth would open, and the teeth would set and every physical reaction of a dog howling or barking could be noted.

### *Does the Head Feel?*

A QUESTION arises now as to whether or not the head of this animal is actually capable of feeling any sensation such as pain. The dog responded to practically every reflex. For example, a 50-candle-power lamp was held some distance away from the animal's eyes, and when the lamp was turned on, the pupils contracted, and the eyes blinked. This was repeated quite a few times. After that, the scientists turned their attention to the mucous membrane of the mouth. They first smeared the mouth and tongue with a small quantity of vinegar. Immediately the head showed irritation, and the tongue made motions to expel the taste and foam developed in the mouth itself. When the same experiment was tried with a small piece of cotton, saturated with quinine (which, of course, produces a very bitter taste) the attempt to push out the irritating substance was even more marked. At the same time, the eyes teared. Sweets and a small piece of cheese were quickly taken and swallowed by the head, only to come out of the severed oesophagus.

*This photograph shows a dog's head on a platter and the rubber tubes leading to the source of blood supply. The head looks very much alive.*

*This photograph shows a group of Russian scientists and students congregating in the lecture room of the laboratory in which the experiments were conducted. It is marvelous that the experiments were so successful with the comparatively crude apparatus.*

### *When Does Life Leave?*

WHEN finally it became necessary to stop circulation, every characteristic of the state of agony and coming death appeared on this bodiless head. This would seem to bring one to the conclusion that the head itself was actually alive. By again beginning artificial circulation, life was again revived and the head reacted as briskly to all irritations and experiments as before.

### *Future Possibilities*

WERE it possible to apply the results of this experiment in the human case, one fairly quivers to think of the possibilities. Imagine a death resulting from any cause. Maintaining circulation might keep a head alive for an indefinite period. Do not even the wildest imaginations of our modern scientific fiction writers pale into insignificance because of the steady advance and progress of scientific research?

If a head can be kept alive for this length of time when completely severed from the body, it is conceivable that the head of one animal could be transplanted to the body of another. Only a few years ago our experiments were looked upon as foolish—Today they have been done.

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*Animal's Head Lives After Being Completely Severed from Body*

**Mechanical Heart Keeps Head Alive**

**Russian Scientists Perform Seeming Miracle**

*The living head of a dog licking the hand of a scientist.*

# The Living Head

By

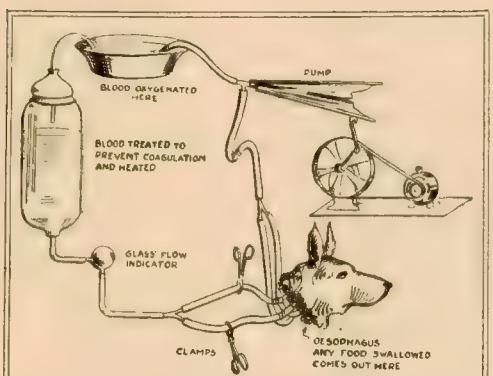
JOSEPH H. KRAUS

IT will be remembered by the readers of this magazine that some few years ago the Managing Editor and this writer undertook a series of experiments in the substitution of artificial organs for the real organs, and as a result, an article was published called "The Artificial Man." This man had an external heart, external kidneys, external lungs and an external stomach into which predigested food was poured. Of course, the artificial man was purely an imaginative creation, but it depended upon actual experiments which were conducted at that time not only with this end in view, but also for the purpose of designing a system in which the blood could be removed from the body, passed through osmotic tanks to clear it of urea and other waste products of the body, thence through suitable X-ray and ultra-violet apparatus to kill any bacilli which might be detrimental to the health, and finally be returned again to the body.

While the experiments were not entirely successful, they were promising enough to warrant further work along these lines and that fact was mentioned in the articles.

The readers will also recall that the heads of insects had been successfully removed from one and transplanted to the body of another, that eyes in fish had been transplanted, and that articles on both of these advances appeared within these pages.

And now we come to the most phenomenal subject of all which is the basis of the present article. We have on these pages actual photographs of the most recent experiments conducted by Drs. C. Brukhenenko and C. Tchechulin, made in the Chemical Pharmaceutical Institute of Science, which is a department of the Scientific-Technical Bureau of the All-Union Supreme Economic Council in Moscow, Russia. Not only do the results indicate that the life of an animal can be prolonged after the head has been completely severed from the body, but they also prove that such severance does not mean instantaneous death.




*A schematic diagram showing the layout of the apparatus, for this experiment with minor details omitted so as not to make it too confusing.*

**FOR many years, scientifiction authors have been regaling us with stories of decapitated heads in which life persisted and fantastic as such stories are, yet, the truth is still more fantastic, for the thing has now been accomplished.**

**Least you denounce the publishing of this article as something too gruesome, remember, that it probably will be the direct cause of saving untold thousands of lives in the future. In cases of accidents to human beings, many of whom have in the past died hopelessly, it will now be possible perhaps to do something about it from the technique gained through these most important experiments. In automobile accidents, and accidents of all kinds, very often, at the present time, people are given up as hopeless. Perhaps in the future, this need no longer be so.**

### *Historical Foundation*

BACK in the year 1912, M. le Galois, a French physiologist, expressed the thought that artificial prolongation of life was quite possible if the conditions for the production and maintenance of the circulation of either the real or artificial blood could be devised. Quite a few scientists tried the effects since that time, but all previous attempts ended in eventual failure. The causes of this failure were variously conjectured upon. In all probability, the lack of success was due to the difficulty of discovering a suitable fluid which could be substituted for the blood.

In our own experiments, we prevented coagulation of the blood by the methods now well known, but our difficulties were that we made no provision for automatically regulating the temperature of that blood and maintaining the necessary respiration or oxygenation. This, the Russian scientists were able to produce. It will be observed by looking at the photographs, that the nature of the difficulties which had to be surmounted were three-fold. The first was of a chemical nature because

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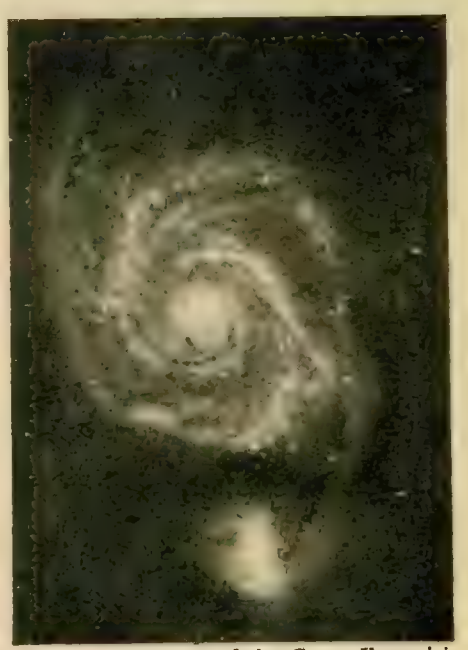
## Light Gathering Power 600,000 Times that of Eye

### New Mt. Wilson Observatory Telescope

**THE largest telescope in the world will have a concave mirror slightly less than 17 ft. in diameter which will probably be made of fused quartz. It is expected that from five to ten years will be needed before its completion. Secrets of the smaller and more distant stars will undoubtedly be revealed by the new instrument.**



*Above is a spiral nebula, Canes Vernatici. This photo also taken with the 100 inch telescope required exposure of three hours. The 200-inch mirror will shorten exposure.*

question was harder to answer. It had previously come up in connection with the present one-hundred-inch telescope which, by now, has proved to be greatly superior to its smaller—though older—sister, the sixty-inch. This fact combined with a careful study of "seeing" conditions, has led to a favorable answer. It seems very probable that a two hundred inch telescope will be correspondingly better than the one-hundred inch. especially if located at a place where unusual steadiness and clarity of atmosphere prevail. Several sites in Southern California and Arizona are being studied, but the final decision of the location has not yet been made.

Question 3 still remains unanswered. The designing and building of the two hundred inch will be one of the greatest feats of modern engineering ever performed. It was decided to make the telescope double the size of the present largest because a lesser instrument would be too near the size of existing telescopes to promise much improvement over them.

### *Problem of Casting Huge Quartz Mirror*

THE casing of so huge a mirror is a very difficult task. Perhaps you may recall how many times scientists at the Bureau of Standards recently had to recast the seventy-two-inch disk for the Ohio Wesleyan Observatory before they finally obtained a perfect one. Glass shows a marked tendency to crack during the cooling process. It is planned to make the new mirror from fused quartz. Quartz does not expand or contract as the temperature changes, hence the danger of breakage during the cooling process is practically eliminated. This property of quartz makes it ideally suited to telescopic use. The normal drop in temperature during a night's observation is often sufficient to warp a large mirror so that its focus may change by a very considerable amount.

The fused quartz industry is relatively new. Dr. Elihu Thompson of the General Electric Company has been the prime mover in its development, and he states that it is quite within the realm of possibility to manufacture a disk of such gigantic size. Preliminary work on smaller disks is already under way at the Lynn Works of the Company.

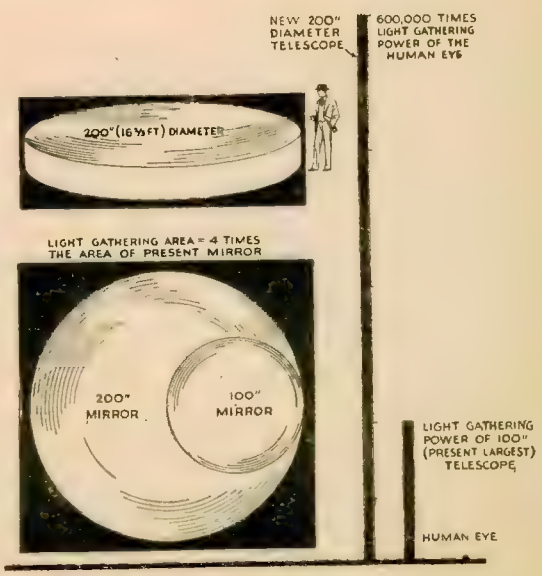
The building of the mounting will not start until it is certain that the mirror will be forthcoming. The moving parts of the one hundred inch weigh a hundred tons, yet, when an observer touches a button, the great telescope swings about as smoothly as though it weighed nothing. This smoothness of motion combined with supreme rigidity is not easily attained. Every metal part must be ground to extreme precision, every girder must be mathematically tested so that it will certainly support the structure without any visible sign of flexure.

*The above photograph which was taken at Mt. Wilson Observatory shows Andromeda, south preceding region resolving nebulosity into star images. This was taken on August 24th, 1925 with the 100 inch telescope.*

### *Five to Ten Years to Build*

EVERY one asks, of course, when will the telescope be finished and ready for use—a question very difficult to answer. If one may judge from past experience, it appears extremely unlikely that the telescope will be ready in less than five years. It is quite possible that ten years may be required. The most uncertain factor is the manufacture of the quartz mirror.

The telescope will be put to many uses.


NEW 200" DIAMETER TELESCOPE
600,000 TIMES LIGHT GATHERING POWER OF THE HUMAN EYE
200" (16⅔ FT) DIAMETER
LIGHT GATHERING AREA = 4 TIMES THE AREA OF PRESENT MIRROR
200" MIRROR
100" MIRROR
LIGHT GATHERING POWER OF 100" (PRESENT LARGEST) TELESCOPE
HUMAN EYE

*A comparison of the present 100 inch mirror and the proposed 200-inch mirror; the light gathering power of each is indicated in the above illustration.*

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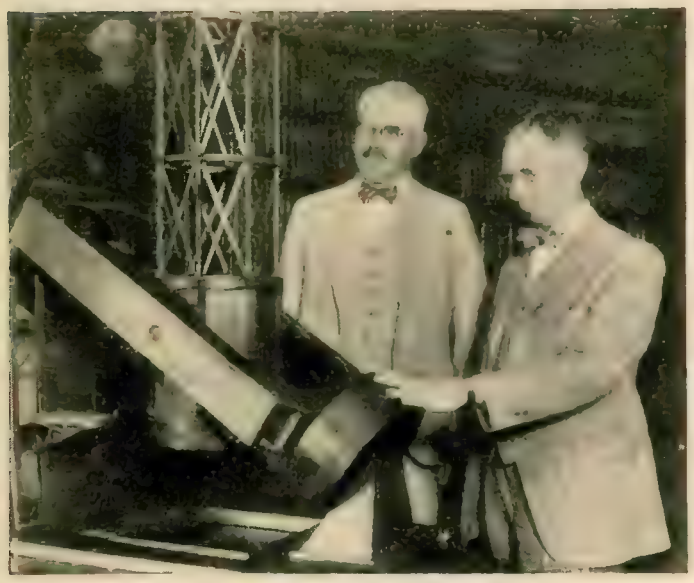
*Details of the 200 Inch Telescope to be built at Mount Wilson Observatory*

# World's *Largest* Telescope

By DONALD H. MENZEL, Ph.D.

**A concave mirror 200 inches in diameter with a light gathering power 600,000 times that of the human eye is to be employed in the new telescope. Fused quartz will be used for mirror.**



*A model of the proposed 200 in. telescope is shown above. Doctors Pease and Anderson are inspecting the model.*

THE International Education Board has just made announcement of an appropriation of a large sum of money to the California Institute of Technology for the purpose of erecting an astrophysical observatory and laboratory. A two hundred inch reflecting telescope is to be the main instrument, and it is to be supplemented with the best auxiliary equipment that can be provided. Arrangement has been made with the neighboring institution, Mount Wilson Observatory, for friendly co-operation and advice so that all may benefit from the knowledge and experience of astronomers that have worked with the one-hundred inch—at present the world's largest telescope. The long list of scientists, who are named as co-workers in the gigantic project, reads like a "Who's Who in Astronomy." Dr. J. A. Anderson of Mount Wilson is in charge of construction and design.

*Fig. 1—The relative sizes of the present largest telescope, at Mt. Wilson which is 100 inches and the projected 200 inch telescope are well illustrated above. This illustration is purely diagrammatical and is not intended to show the appearance of the finished instrument.*

### 600,000 *Times Better Than Eye*

A TWO hundred inch telescope! A concave mirror two hundred inches, a little less than seventeen feet, in diameter, with a light gathering power roughly 600,000 times that of the unaided human eye! The conception of so colossal an instrument almost defies the imagination. A sketch is shown herewith (Figure 1), illustrating its size compared to the one-hundred inch. The diagram is, of course, schematic; it is quite certain that the new instrument will not be built upon lines similar to the Mount Wilson telescope. (See also photograph reproduced at left.)

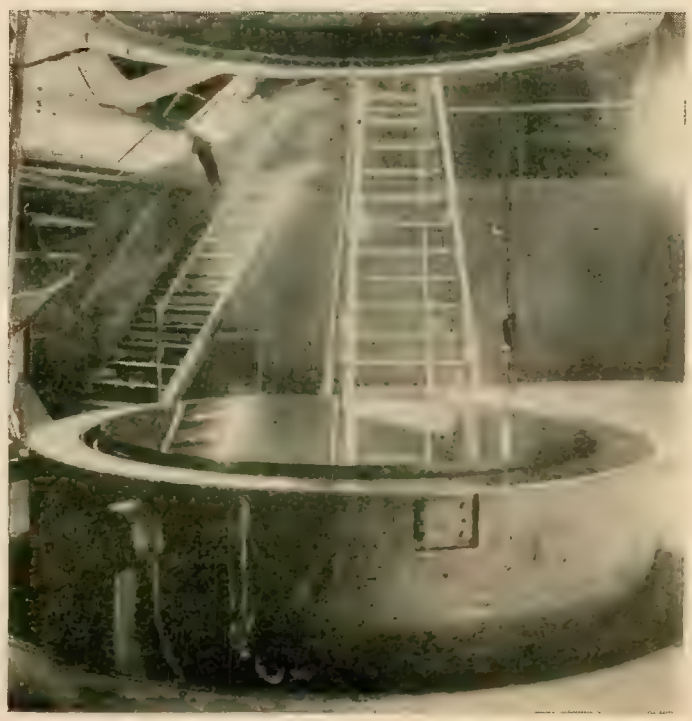
### *Cost of Telescope*

THE actual amount of the gift has not been announced, but, since the Mount Wilson hundred-inch is known to have cost in the neighborhood of five hundred and forty thousand dollars, it is quite obvious that the cost of the new instrument will be many times greater—possibly four or five million dollars. It must not be thought that the gift of so much money was idly made.

A great many factors had to be weighed and considered before the project was finally decided upon. There was the fundamental question: will the knowledge contributed by the instrument justify its existence? Secondly, disturbances of the earth's atmosphere are always troublesome. May not the new telescope so magnify them that its greater light-gathering power would be neutralized by the poor quality of the images? Thirdly, can such a telescope actually be built and how large should it be made?

### *Desirability of 200-Inch Telescope*

TO the first question astronomers immediately gave a resounding "Yes." There are hundreds of problems that such an instrument would be ideally suited to. The second



*A photograph of the present 100 inch Mt. Wilson Observatory telescope appears above. This view shows the mirror well. The 100 inch mirror, however, only has one-quarter of the light gathering power of the 200 inch mirror to be used.*

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*Fig. 3. The appearance of a notch in the North Equatorial Belt to the north of the red spot on June 30th, 1901 and deformation of the equatorial cloud belts on October 18, 1905, and also on the 15th of April, 1906.*

on Jupiter's surface known as the Great Red Spot *is not a fixture on the planet's surface!* It possesses an extremely oblate spherical outline and its major-axis measures over 20,000 miles. Its slow, irregular drift on the planet shows

* This conception of a forming continent on Jupiter was broached by E. M. Antoniadai in an article in "L'Astronomie" of Paris in April, 1911. The terrestrial granitic continents, in their initial stages of formation, were likewise thin crusts floating on the hot and liquid globe. According to Geikie, the highlands of Guinea in South America thus emerged as an oval area 700 miles long by 600 wide above the steaming oceans of the Paleozoic Era, exactly like the present Red Spot on Jupiter. (See Chart, Fig. 5.)

## *How the Great Red Spot on Jupiter May Become the Ninth Moon*

that, while it is detached from the main globe, it moves around with that planet's axial rotation. The inference denotes a Jovian moon in embryo.

The Great Red Spot, Jupiter's embryo ninth moon, which was 23,500 miles long by over 8,000 miles wide when first discovered in 1878, has been more or less permanent in place during the past half-century of its existence, as Figs. 2 and 3 show. The first drawing by Franks shows its aspect on August 23rd, 1879, shortly after its discovery. On October 3rd, 1879 the spot achieved its widest area and strongest development, while by June 30th 1901 (Fig. 3) a notch had appeared in the equatorial belt to the North. On September 18th, 1927 it was in (Jovian) longitude 340 degrees and had a rotation period of 9 hours, 55 minutes, 35.53 seconds, or some four seconds slower than a year previous. Further, the darkest core of the great spot has migrated some five degrees further south in latitude than its position in 1916, according to Latimer Wilson of Nashville. The direct inference is that the spot is gradually losing its organic identity with the planet Jupiter itself. (See Fig. 4.)

### *Semi-Solid Moon*

IN his "Growth of a Planet" Edwin S. Grew hazards a suggestive opinion that the Red Spot may be an island floating unstably upon the surface of a liquid planet*, but inclines to the conception of a separating portion of Jupiter obscured periodically by cloud currents. The swiftly changing belts of cumulus on Jupiter must be of some substance that condenses at a far lower temperature than water and would boil at—100 degrees C. (—140 degrees F.).

In Fig. 6 are shown Bolton's drawings of the Red Spot at successive epochs, years apart, indicating deformations altering the cloud belts and the spot outline itself. Early in 1919 the Tropical Disturbance and the Red Spot hollow both vanished, although the spot itself survived. A stage intermediate between the sun and the earliest terrestrial geological periods is indicated; favorable to satellite formation through rotational fission. Jupiter, in short, is a planet not yet solidified, and the conception of a semi-solid moon sloughing off into space through instability arising in rapid axial rotation is plausible.

Summarizing this theory, Scriven Bolton concludes with the words: "A later stage of evolution will see it (the Great Red Spot) clear of the surface and constituting an additional member of the Jovian system of satellites. Its present unsteady motion and irregular rotational period is attributed to the influence exerted upon it by adjacent surface disturbances, but when it is once launched into space it will be free to move as steadily as the other satellites."

The present red spot has usually been situated in a curious basin or hollow, in the south side of the southern equatorial belt. The hollow has been in almost continuous evidence since September, 1831. The average rotation speed of this object has been nine hours, fifty-five minutes, 36.8 seconds, and about eighty-one thousand rotations were performed in the interval to 1923. Hooke was the discoverer of the great spot on Jupiter in 1664. This spot may well have been closely connected, if not identical, with the present Great Red Spot. There are many analogies of position and motion which suggest that they were the same.

(*Continued on page 978*)

*Fig. 2. Below is shown the development of discovery in 1878 up to September 30th, 1880, the Great Red Spot on Jupiter following its showing alteration of form.*

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*Fig. 4. The above illustration shows the birth of Jupiter's ninth moon by tidal fission of the red spot from the parent body.*

# Jupiter's Moon in the Making

## By DONALD P. BEARD

STARTLING changes, shifting of cloud belts and alterations in the form and motion of the Great Red Spot on Jupiter have occurred within the year past. News of an eruption more colossal than a thousand Etnas came from Prof. Schaer's observatory on the Jungfrau, Switzerland on October 15th, 1927. The dispatch reads like the opening of H. G. Wells' amazing "War of the Worlds," yet it remains sober fact, not fiction.

Prof. Schaer, a German astronomer at the University of Geneva, spent ten nights at the Jungfrau Observatory, 11,340 feet above sea-level. While observing Jupiter through the 10-inch Zeiss refractor there, Prof. Schaer noted "a luminous eruption on the planet which lasted an hour, and the light, more intense than that of Jupiter's satellites, was visible between the two equatorial belts of the planet."

Other recent observations indicate that the Great Red Spot, long a prominent feature of the planet, is now wholly severed by obscure Caesarian forces from the parent body of Jupiter and is actually pursuing an independent motion about the latter!

About twenty years ago Sir George Darwin sought to apply the principles of the doctrine of natural selection to certain unstable planetary species under rapid rotational stress (much as in specimens of amoeba) leading to ultimate fission as in Fig. 1. Sir George calculated that 54,000,000 years ago our own moon was sundered thus from the earth which, in that remote epoch, was rotating once in five or six hours. Under a condition of low density and high centrifugal stress, sufficient rotational instability was developed to slough off the moon-mass from the present circular basin of the Pacific Ocean. This process has been termed "tidal evolution" and its failure to transpire would have created a tideless fishpond of the entire earth's surface, inhabited today by amphibians instead of human beings.

*Fig. 5. The first land surfaces in Palaezoic times, (see arrow) showing oval highlands of Guinea, in South America, north of the equator.*

*Fig. 1. Fission in a paramecium, which illustrates the formation of satellites from rotational instability. Sir George Darwin advanced this principle twenty years ago.*

### *Red Spot Is Ninth Moon*

BRIEF summary of this theory prepares us for the recent statement made by Scriven Bolton of the Royal Astronomical Society of Britain that the famed Red Spot, so long an enigma, is nothing less than a ninth moon in process of formation! His belief is based upon systematic increases in the rotation period of the Great Red Spot over a period of a half-century, following its discovery in 1878 by M. Niesten at Brussels.

In outlining his theory Scriven Bolton writes: "There is at present a phenomenon which suggests an epoch in the evolution of moon-making processes in the solar system. That puzzling object

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*The above photograph shows the oxygen bag and mouthpiece in place.*

*The 5,000-lb. diving bell which simulated a compartment of a sunken submarine is shown above being lowered in place. Three tests were made with the bell and all were completed successfully.*

*One of the divers is shown above ascending to the surface.*

city of Washington, were made of scrap material and weighed an average of 4 pounds each. The use of better materials and greater refinement in production will result in a shrinkage of at least two pounds in the current weight of the unique life-savers. The *lungs* are small enough so that a full equipment of them can be carried on every submarine, of which there are now over 80 in active use in the American fleet.

A man in a disabled submarine can don one of these new-fangled breathing devices in from 5 to 30 seconds. The apparatus resembles the historic army gas mask and consists of a rubber bag which straps on the chest and contains the requisite amount of oxygen and a small canister of soda lime to purify the foul air expelled from the lungs. Its carbon dioxide content is purified so that the same air may be breathed again and again. The rubber mouthpiece of the lung fits tightly against the jaws inside the mouth so that it cannot slip out of position during escape from the "sub" and ascent to the sea surface. As the sailor grabs his *lung* from its appointed place in the submarine, he will charge it with the necessary amount of oxygen, carried in special tanks placed in a strategic position near the double-doored ports, from which future egress from sunken submarines will be made.

### *Tests Made with Diving Bell*

THE first tests in the Potomac River were made by use of a steel diving bell. This diving bell is made of one-quarter inch steel, weighs two tons and has a base platform on which 1½ tons of ballast can be placed to insure that it will remain on the bottom when lowered to the desired position. It has a compartment large enough for the accommodation of four experimenters. This compartment which has no bottom is kept free of water by air pressure, the air being pumped from the accompanying ship and admitted to the subsurface chamber by means of a special control valve and extendable hose line. The diving bell was used in the first tests as a simulation of a sunken submarine.

The bell was lowered to a depth of 110 feet where it found bottom in the mud. Lieutenant C. B. Momsen, one of the inventors of the new and novel *lung* was the first to test out the device. Lieutenant Momsen and his assistant, Edward Kalinoski, dressed in bathing suits dived into the Potomac and entered the bell where it was suspended by chain from the stern of a naval vessel. The bell with increasing air pressure being blown into it was then lowered to the bottom of the river. The lifeline buoy, a small life preserver of cork was then released. It is capable of sustaining an average man's weight in water. Lieutenant Momsen donned his lung and dove from cramped quarters in the bell and ascended the lifeline slowly so that he would suffer no injury from too rapid decompression and the excessively rapid expansion of air in his system.

*A diver is shown coming up to the surface during one of the tests made in the Potomac River. He has come up on the lifeline slowly so that he would suffer no injury from too rapid decompression. Note the lifeline buoy which the diver is grasping. The mouthpiece of the man-made breathing device can also be seen just above the surface of the water.*

### *To the Surface in Two Minutes*

IT took two minutes for the naval officer to make the 110 foot ascent to the surface. All he had to do was to press an escape valve on the rubber breathing bag and allow some of the oxygen to leak out if at any time the air supply became too rich for ordinary breathing purposes. Joseph Eigen, a naval diver, made a descent and ascent after Lieutenant Momsen reached the surface.

In all respects the breathing bag or lung proved satisfactory. A few days after the first tests were made, the program was repeated at a depth of 150 feet. Previous to the tryout of the lung in the water it was tested thoroughly in the diving bell at the Washington Navy Yard, at a depth of 60 feet where it proved its merit.

All that is necessary in equipping submarines now in service with the new rescue apparatus is to provide practical escape hatches as annexes to the regulation subsea ship's compartments. These compartments will be so designed as to act as natural diving bells when the submarine is flooded. The crew and officers trained in such manoeuvers can quickly don their "lungs," escape through these hatches and make their various ways to the surface on the lifelines attached to the cork buoys which would soar to the surface in the inverse way to that pursued by a parachute in sailing to land from the sky.

(*Continued on page* 960)

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# MECHANICAL "LUNGS"
## for Men entrapped in Submarines

By G. H. DACY

**New life savers for sunken submariners developed by U. S. Navy divers**

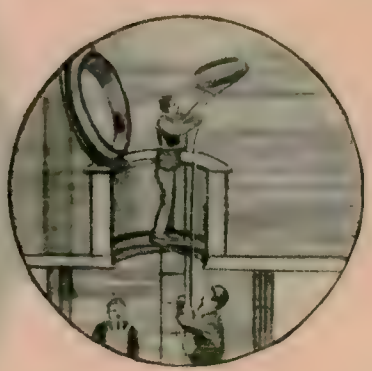
*The above photograph shows a navy diver in the new escape lock device aboard the re-conditioned submarine S-4.*

POTENTIALLY the subsea will be robbed of its former quota of victims—those who sink in crippled submarines never more to see daylight and enjoy life ashore.

Divers and engineers of the U. S. Navy have perfected an artificial *lung*, a safety device for universal use on submarines which will enable trapped crews and officers to leave sunken undersea craft at will. It is without exception the most efficient and condensed apparatus of its kind ever invented. It excels all the foreign appliances originated for similar purposes and lacks the bulk and cumbersomeness of such safety contrivances now available

Aviators have reliable parachutes to extricate them from impending aerial disasters, soldiers in the trenches are protected against deadly gases by practical .gas masks. And now our submarines are gladdened by the successful underwater rescue tests made with the new lung which eliminates the greatest peril from subsea ship service.

The lamentable submarine S-4 disaster, fresh in the minds of Americans, would never have occurred if the new device had been invented but a few months sooner and installed as standard equipment on American submarines. It is qualified to aid the escape of entombed submarine crews at depths of 225 feet or less. In the future, it probably will be improved so that it can be used at greater depths.

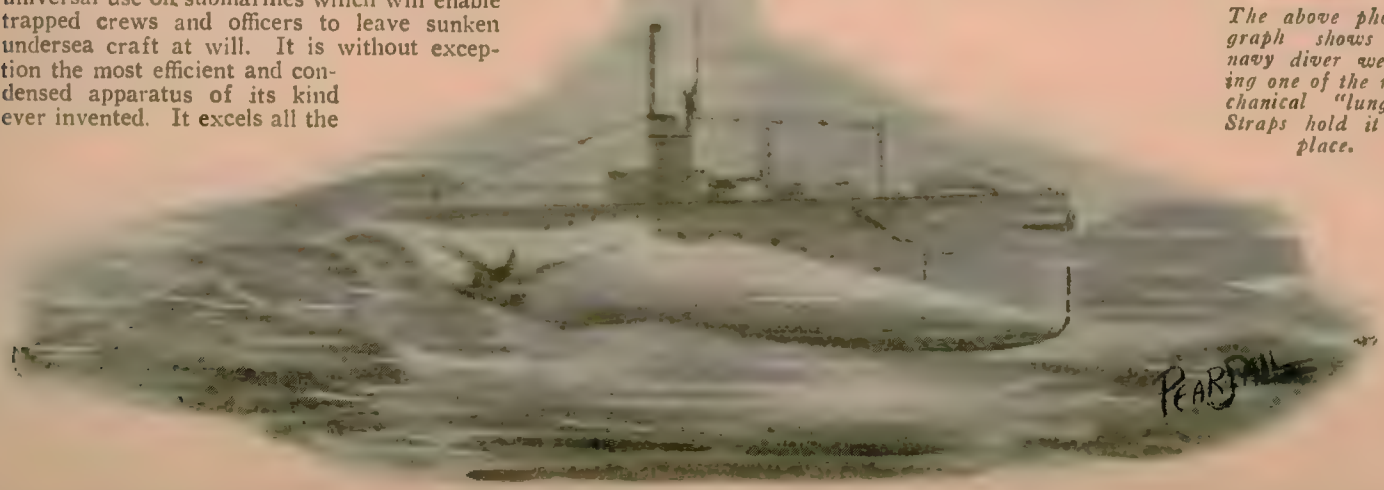


*Above — entrapped crew equipped with "lungs" are sending up a rescue line to the surface. A lifeline buoy is attached at the upper end and will sustain a man's weight.*

*The above photograph shows a navy diver wearing one of the mechanical "lungs." Straps hold it in place.*

### *Light Weight*

THE test *lungs* used recently in experiments in the Potomac River, near the ordnance proving grounds of the U. S. Navy, south of the

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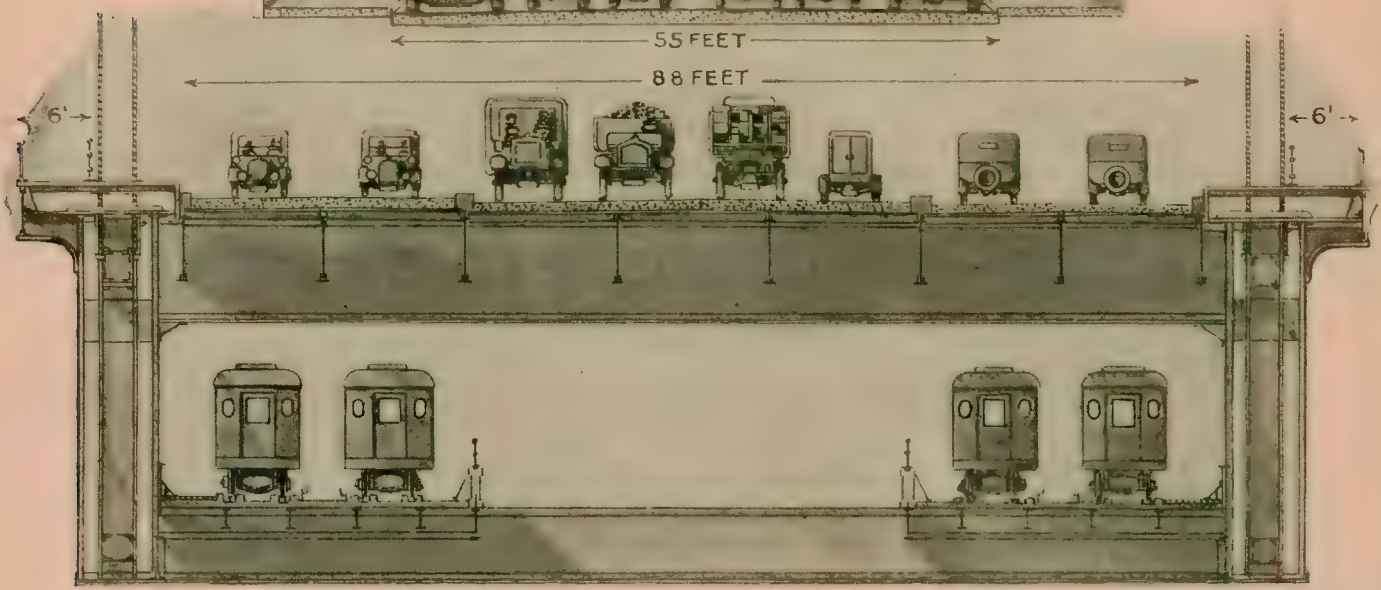
*The traffic roadway on Fifth Avenue and that of the new bridge are compared in the illustration appearing here. The bridge roadway will be 88 ft. wide.*

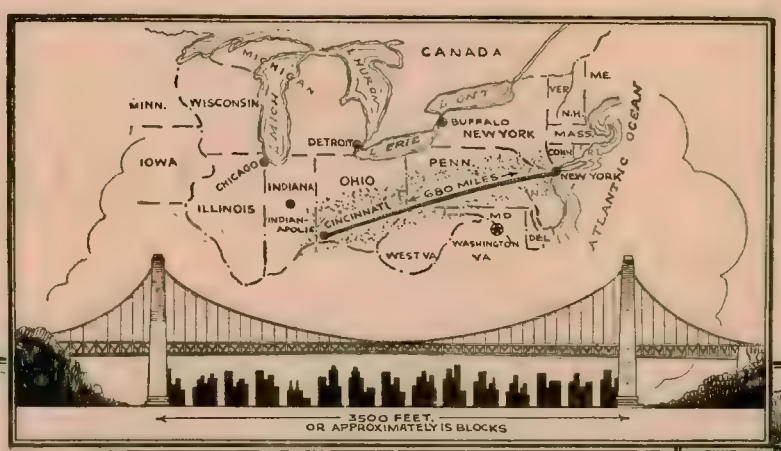
*On either side of the bridge there will be a 6 ft. sidewalk for pedestrians. Below the vehicular road will be four tracks for trains.*

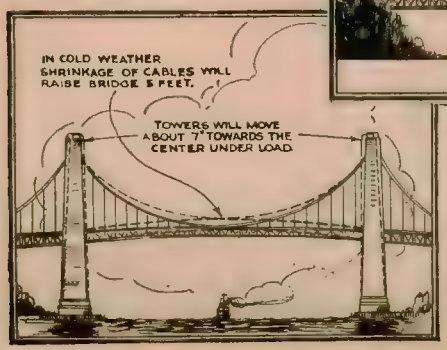



*The floor of the bridge is hung by pairs of steel wire suspenders from four wire cables. On the upper deck is an 88 ft. roadway which will accommodate eight lines of motorized traffic. This deck is carried on transverse floor beams spaced about 60 ft. apart.*

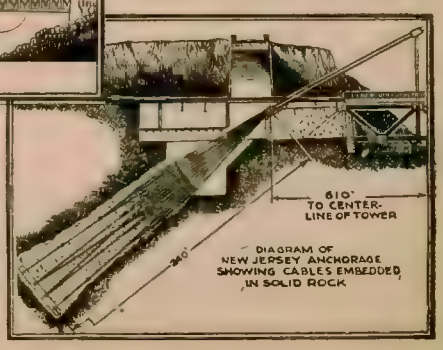
*The lower deck of the bridge will carry four rapid transit lines. This makes it necessary to have a large railway terminal at the Manhattan end of the bridge and an elevated structure crossing Manhattan at 59th Street for direct connection with Long Island.*

most impressive connection between New York and New Jersey which has ever been made. It will aid the ferries and the vehicular tunnel in bridging the gap between the two states and will further afford an outlet for metropolitan inhabitants. It will also be a main auto highway connection between New England and New Jersey, Pennsylvania and the south that will avoid to a large extent the congested districts of New York and vicinity. The bridge will open a large area of New Jersey as a suburban district for New Yorkers. Traffic surveys and estimates indicate that 8,000,000 private vehicles and nearly 500,000 buses will use the bridge in the first year after it is opened. The theoretical capacity of the roadways of the bridge is nearly 30,000,000 vehicles per year, but it is assumed that before such a volume of traffic is reached, other Hudson River crossings will have been provided. By 1960 traffic is expected to increase to 16,000,000 pleasure vehicles and 1,000,000 buses. Traffic coming along the Lincoln Highway from the south will pass around Newark by a route soon to be constructed and will cross the bridge to Manhattan far from the congested area. The Washington Bridge across Harlem River will connect with the Bronx and the Boston Post Road.




*The above illustration shows the total length of steel cable used on the bridge which would reach from New York to Cincinnati. At the left we see how provision has been made for contraction and expansion. At the right is a diagram of the New Jersey anchorage showing how the cables are embedded in solid rock. The four 36 in. cables will be jointly able to support a load of 352,000 tons.*

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# Giant Bridge Joins Two States

## New York and New Jersey to be Connected With a Span 1½ Miles Long.

By H. Winfield Secor

*The main elements of the bridge will be the great span across the river, the supporting towers and approaches. Above one of the towers is compared to the Woolworth Building which is 792 ft. 1 in. high. The bridge towers will be 650 ft. in height.*

IN the January 1928 issue of this publication a complete description of the greatest bridge in the world, which would span the Hudson, was given. Now, one year later, we are giving further data and interesting facts concerning the colossal suspension bridge which will be 1½ miles long, with towers standing 650 ft. high.

The supporting columns will rest upon separate concrete bases 90 ft. x 100 ft. faced with granite. To build these foundations, the river bottom was excavated for about 100 ft. under water to reach bed rock. One of the towers is compared to the Woolworth Building in an illustration on this page. Photographs of the 16 section steel skeletons for the towers also appear. The towers will be of steel and concrete construction with stone facing. Two sidewalks each 6 ft. wide and a roadway for motorized traffic 88 ft. wide will be supported by these towers, as well as four rapid transit lines. The cables for the bridge of which there are four, each 36 in. in diameter made up of small wires 1/5 in. in diameter, will be anchored in solid rock. The drawing appearing here shows a diagram of the New Jersey cable anchorage which will be 240 ft. deep. The weight of the bridge and therefore its inertia will be so great that the force of a gust of wind would be spent before the bridge would move appreciably. The steady force of a high wind would hold the center of the bridge 12 or 18 inches out of its normal position. However, a maximum swing of 5 ft. has been allowed for. In cold weather, the contraction of the cables will raise the bridge about 5 ft. and the two towers will move about 7 in. toward the center under a load. The concrete floor will be supported from the suspension members by great steel trusses which will allow the bridge to swing without their breaking or cracking. The Hudson River Bridge will have a span of 3500 ft. which is twice the length of the Camden, N. J., span. The weight of the suspended structure will be 120,000 tons and the weight of the complete bridge is estimated as 1,000,000 tons. The live load carried will be one-quarter of the dead weight. To resist the pull of the cables on the New York side, at 179th Street, a concrete anchorage weighing 370,000 tons is to be used. The bridge will be the

*In the above photograph may be seen the steel skeleton of one of the towers. Each leg of the tower rests on a separate reinforced concrete base resting on bed rock and faced with granite. Arrows point to workmen.*

*A view of one of the towers taken while standing at the base and looking upward appears at right. The 16 section steel columns that form the New Jersey tower of the giant span have risen to a height of more than 200 ft. in two months. The towers of the bridge are four times as high as the famed Colossus of Rhodes.*

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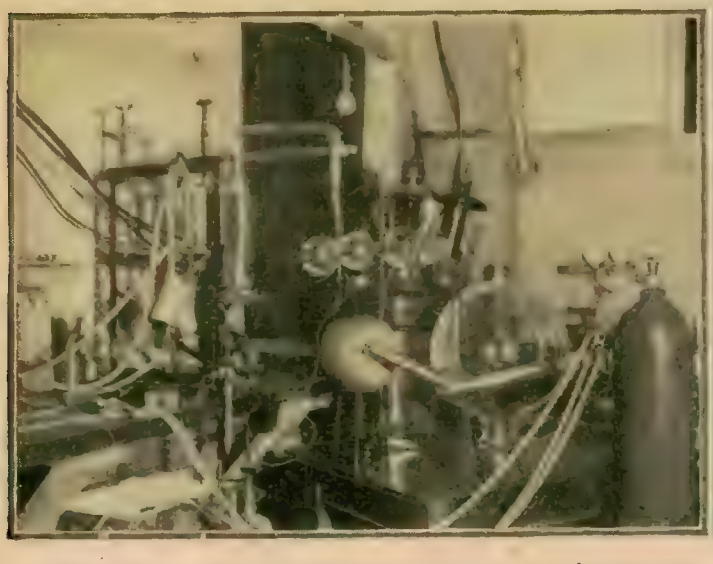


*The above photograph shows the vacuum tubes and apparatus designed for use in the high voltage experiments. Special tubes withstanding a pressure of 1,000,000 volts were developed in connection with the work.*

*The high voltage equipment designed at the Carnegie Institution appears above. The high pressure tank, condenser, spark gap and measuring gap may be seen. Doctors Tuve and Gaviola and Mr. Hafstad are shown in the photo.*

# Shattering *the* Atom

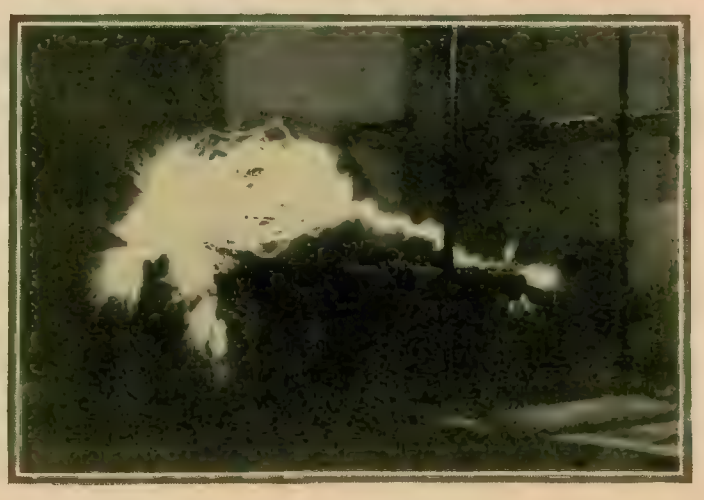
## *Scientists of Carnegie Institution Bombard Atomic Nucleus*

## *Five Million Volt Apparatus Developed for Tests*

SCIENCE has launched another attack upon that extremely minute particle of matter, the atom. To gain an idea of the infinitesimal dimensions of the atom let us suppose that a drop of water were magnified many, many times until it were the same size as our earth. Then, the constituent atoms would be the size of footballs. If the nucleus of a hydrogen atom were magnified to the size of a pea, then the single electron which courses in its orbit about the nucleus, would be represented by a sphere thirty feet in diameter and the circumference of the atom itself would be a circle having a diameter of 600 miles. The limit of our vision with the most powerful ultra-microscope is a particle with a thickness of about one three millionth of an inch, which is still about two hundred times the width of the calculated atom. However, science triumphs in strange ways and through the noteworthy work done in the Department of Terrestrial Magnetism, of the Carnegie Institution, man has succeeded in producing a higher electrical voltage than ever before obtained. With this equipment, developing a pressure of 5,000,000 volts, it was possible to bombard the atomic nucleus with high voltage projectiles, and so actually shatter an atom.

### *High Voltage Equipment*

IN order to develop a suitable laboratory source of high electrical pressures, a high frequency resonance coil was used, undoubtedly more familiarly known as a Tesla coil. This coil was immersed in an insulating oil under pressure to prevent spark discharges from the surfaces of the caps on either end of the secondary. The coil was excited through the primary circuit which consisted of a large glass plate condenser, a spark gap and a primary coil consisting of two turns wound about the secondary. The condenser was charged to a potential of 50,000 to 100,000 volts and discharged through the spark gap thereby setting the high voltage coil into oscillation and building up the tremendous pressure of 5,000,000 volts between two balls at the end of the secondary. The schematic diagram of the high voltage apparatus and the approximate voltage and time relation are shown in an accompanying drawing. Special vacuum tubes which would operate at voltages as high as 1,000,000 volts were developed. In order to produce particles of sufficiently high speeds to penetrate the central structure of the atom called the nucleus, their velocity must be increased enormously by being released at one of the electrodes of a vacuum tube to which a million volts or so is applied. The quest for a high voltage tube still continues, although tubes have been made to operate for a short time at 1,000,000 volts. Doctors Lauritzen and Bennett, of the California Institute of Technology, are responsible for the development of the million volt tube.



*The above photograph shows a spark discharge in air obtained from a Tesla coil operating at 300,000 volts. A large coil of this type will not operate much above this voltage in air because of the large sparks and streamers and corona discharges.*

### *Future Energy*

ATTENTION is now being turned to a new source of energy derived from atomic disintegration or the breaking up of atoms. Scientists will some day find a method of breaking up atoms of common elements. The work at present is in the embryonic stage.

The energy of the future lies in atomic disintegration which will supply unheard-of power.

(*Continued on page* 960)

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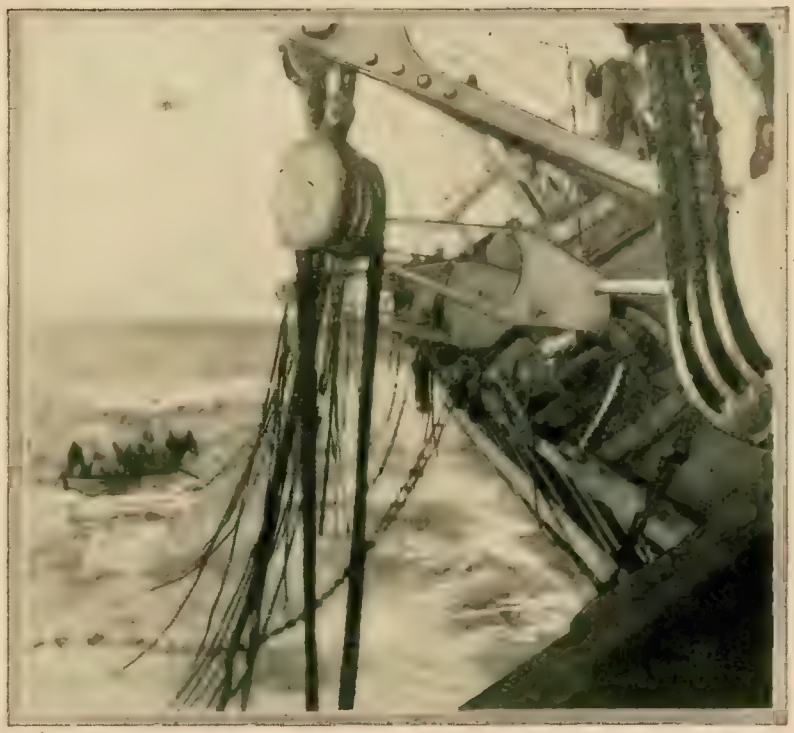
# New Safety Lifeboat

(Continued from page 911)

these ideas, and while the final construction may not be exactly as the one shown here, still I believe it is pointing the right way, and should sooner or later be adopted.

My idea of a modern lifeboat is a sort of steel pontoon, about 80 ft. long and about 14 ft. in diameter, the entire pontoon to be made of steel, about ⅛-in thick for lightness and for strength. The illustrations give you a rough idea of this new future lifeboat.

I do not wish to convey the impression that this pontoon is a miniature submarine, which, of course, it is not. It is constructed with the sole idea to have buoyancy and to stay on top of the water. It is not constructed to withstand great pressure, as the submarine must be, and for that reason the life-pontoon can be made very light; yet, comparatively strong. The inside of the pontoon is strengthened by circular cross-ribs to give the boat great rigidity, which it requires for reasons which will be apparent. At the same time, its cost should be such that it will not be very much more expensive than a quantity of lifeboats, whose places it takes.



*Another remarkable photograph of the actual sinking of the VESTRIS. Here we see the ship listing at a perilous angle with one of the lifeboats making away at the left. This picture illustrates vividly how difficult it is to attempt lowering an open lifeboat.*

Copyright 1928 by Pacific & Atlantic Photos.

The average lifeboat accommodates, roughly, 32 people. The life-pontoon takes, roughly, 200 people. From this, it will be seen that not many of these pontoons are required on the average ship; and even the biggest liner, which carries some 2,000 people, passengers and crew, would only require, therefore, ten pontoons.

The principle of the lifeboat pontoon may, in a few words, be described as follows:

### *Easy Launching Features*

THERE is no need of ever launching the life-pontoon except in one instance, and that is fire. In all other cases, such as collision, etc., where the boat sinks, *the life-pontoon need not be launched at all.* When danger threatens, the passengers are made to enter the pontoon, several officers supervising them, so that only a certain number of people will go into one pontoon, and so that no overcrowding occurs. Once they are safely inside, the door is locked and bolted, air and water-tight, while the officers see to it that the passengers are strapped into life straps provided for this purpose, which will shortly be apparent. These life belts or life straps are fastened to the inside wall of the life-pontoon, which itself is padded, similar to a padded cell. All of this fastening can be done in a minimum of time. The same thing occurs with the other life-saving caissons, and nothing further remains to be done except wait for the ship to sink. Before this happens, however, the officers will have made sure that the pontoons have been disengaged from their normal fastening supports, (Continued on page 999)

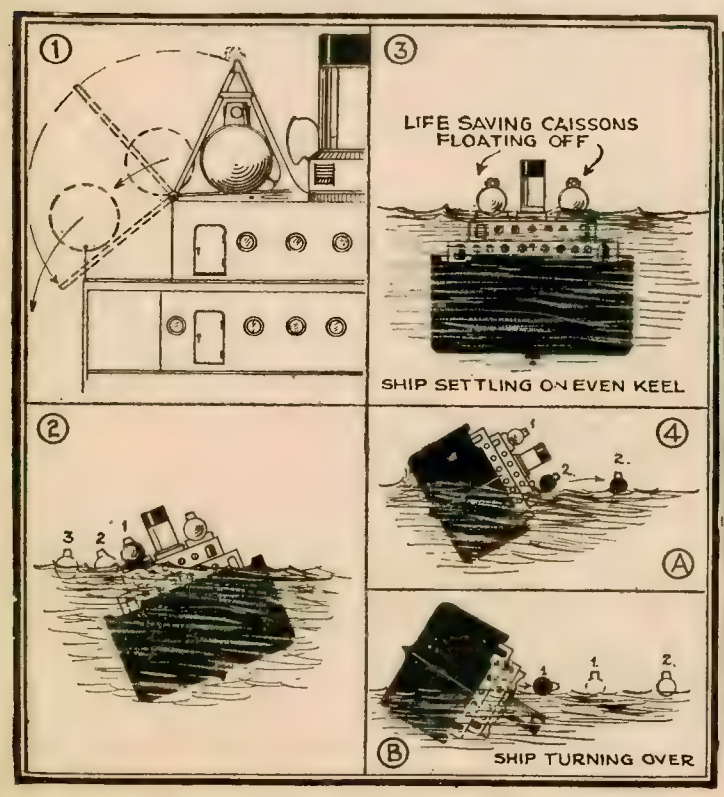
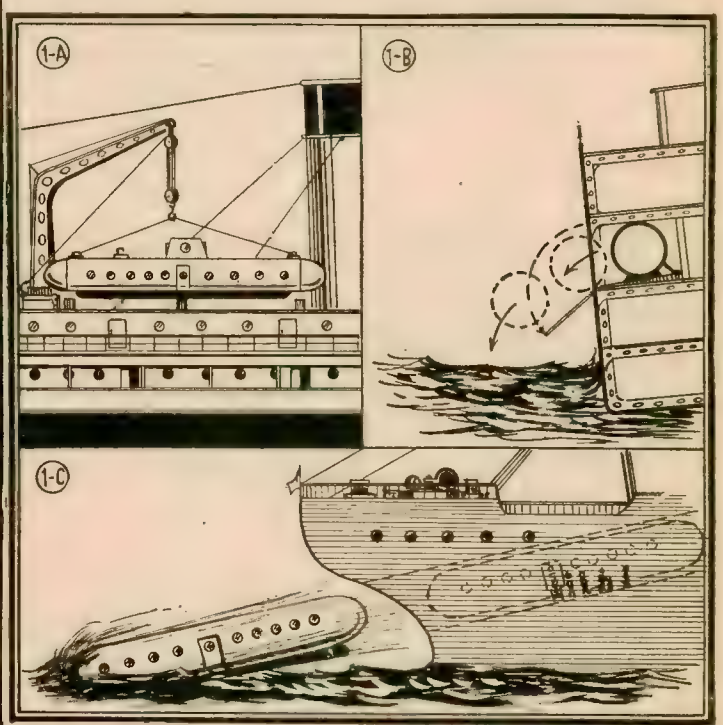



*Figure 1 shows how the new life saving-pontoon may slide down to the sea in case of fire. Figures 2, 3, 4, A and B, show life-pontoons as they leave the ship and float off.*




*1-A shows how life-pontoon may be launched by means of crane. 1-B shows how life-pontoons might be stored below decks, if necessary. 1-C shows another variation how life-pontoon might be launched. This latter variation is, however, not practical in case the ship goes down stern first.*

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# New Safety Lifeboat

## *VESTRIS Disaster Demonstrates That Present Day Open Lifeboats Are an Anachronism*

By HUGO GERNSBACK

*Member: American Physical Society; American Association for the Advancement of Science*

THE sinking of the *Vestris* again teaches that the present-day open lifeboats are totally unfit for life-saving purposes. Lifeboats are very much like Mark Twain's weather: "Everybody talks about it, but nobody seems to do anything about it."

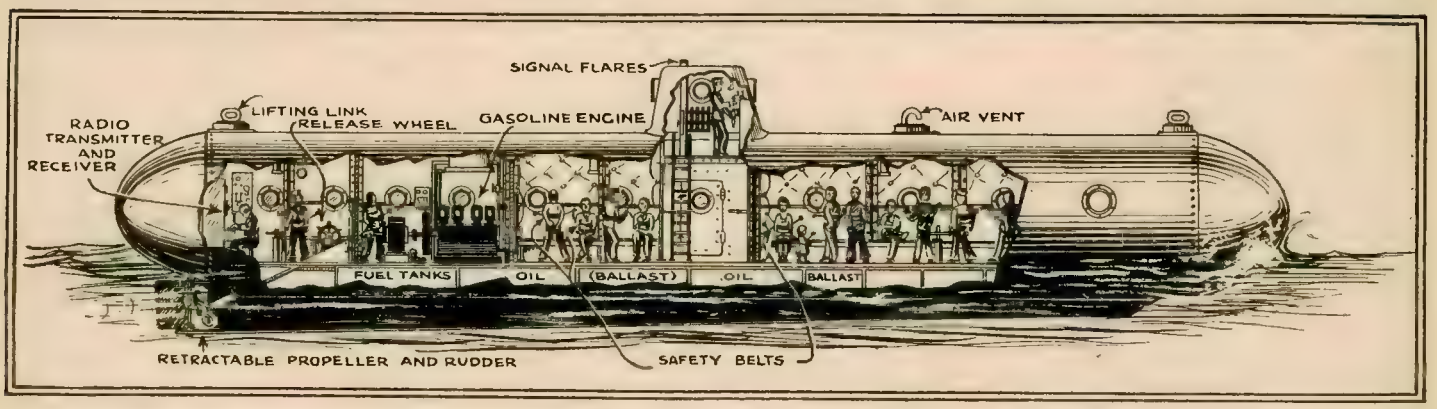
If the *Vestris* disaster were the first one in which a huge loss of life was caused directly by the fact that the lifeboats might just as well not have been in existence, there would perhaps be an excuse; but similar occurrences, such as, for instance, the *Titanic* and *Lusitania* disasters conclusively prove that the open lifeboat is not to be trusted; particularly when the sea is rough and when the disaster is of the variety where the ship goes down quickly, as was the case with the *Titanic*, the *Lusitania* and now the *Vestris*.

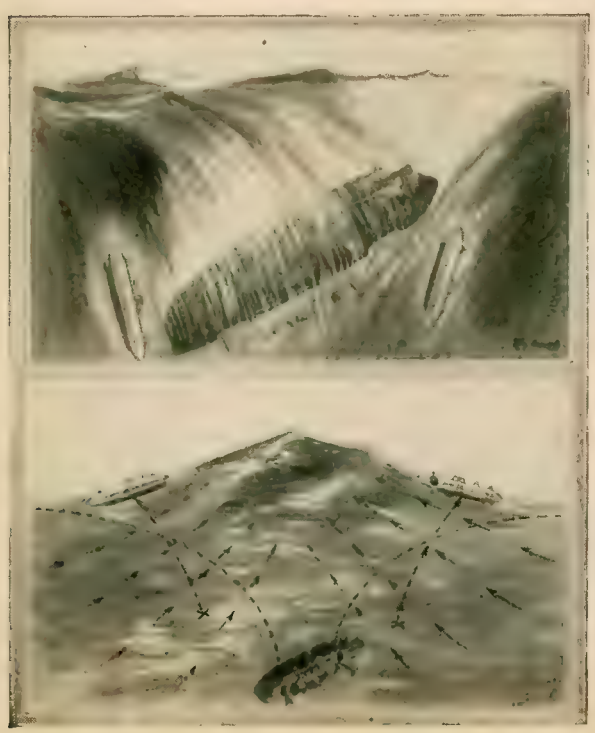
### *The Vulnerability of Open Lifeboats*

WITH present-day lifeboats, it is always the question of the human element. In the first place, the listing of a rapidly sinking liner is usually so great that even with a heroic crew, it becomes often impossible to safely launch a lifeboat at all. There is no crew living which has ever been trained to put lifeboats into a heavy sea with a ship listing 30 or more degrees. The usual lifeboat drills are silly, because the conditions under which they are made are totally different from what usually happens in a disaster.

*The most remarkable picture ever taken of a disaster; this shows the crew of the VESTRIS with lifebelts rushing to the lifeboats. Many of those shown were drowned.*

Copyright 1928 by Pacific & Atlantic Photos.



*Cross-section of the new life-pontoon to accommodate 200 passengers. The entire inside is padded so as not to hurt the passengers in a rough sea or during launching. Safety belts are provided to hold passengers fast to their stations, in order not to break limbs and injure passengers.*

*In very extreme cases there is a suction as a steamship goes down. The life-pontoons might be carried down for 15 or 20 feet as shown in the upper illustration, but would immediately bob right to the surface of the sea, as shown in the lower illustration.*

But granting that some lifeboats can be safely launched, we then have the *Vestris* experience, where many people perished because the lifeboat upsets or becomes filled with water, and either capsizes, or what is worse, many of the unfortunate survivors die of exposure; and the few who are saved usually contract pneumonia or die from the effect of exposure. So all in all, the present-day open lifeboat is to be severely condemned as an anachronism and is to be placed in the same class with sail ships, of which it is only a miniature duplicate.

### *Brand New Lifeboat Needed*

WHAT then is needed is a totally different sort of lifeboat, suited to modern conditions; a lifeboat that cannot be swamped by the open sea; a non-wooden lifeboat that is seaworthy, that will not fall apart when it is launched into the sea, and what is more, a lifeboat that is not dependent upon a panicky crew for its launching.

The illustrations on these pages illustrate (*Continued on next page*)

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*This illustration shows the launching of the Gernsback life-pontoon in the extreme case where fire breaks out in the ship. The pontoon is easily released from its davits and slides down into the sea, passengers and all. The passengers are strapped with leather life belts inside of the padded pontoon, so they will not be hurt as the pontoon rolls over in the sea, for a few minutes, till it rights itself.*

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# The Answer

## TO

## THE QUESTION

# Can We Control Sex?

IT will be remembered that SCIENCE AND INVENTION Magazine sent out questionnaires to a group of 587 select authorities throughout the country. The consensus of opinion of these men, well versed on the subject of sex, will be of interest to the reader.

As already mentioned in the text appearing in the center of this page, the syngamous theory of sex determination was held in 66 per cent of the cases.

On the subject of sex control itself, the votes were two to one in favor of the negative side of this subject, but we are writing about those who made unqualifying statements, either a definite "yes" or "no." There were, however, again as many votes as these two groups combined, who believed that *there was a possibility of controlling the sex in human beings, and that this will some day be discovered.* The answers to most of the other questions were negative by the vast majority, with the exception of question 10, information about this is here subsequently given.

Scientists definitely stated that the diet has no effect on controlling the offspring in the human individual.

Scientists scoffed the theory that the time of fertilization with reference to the menses has any effect.

The theory that the sex of the offspring sways to the weaker, was definitely rejected, but here there were a few more dissenting votes.

Question 10 read as follows: Do you believe heredity has anything to do with sex?

1. A and B marry. In A's family there are four males and one female; in B's family there are six males. Is it likely that males will predominate in the offspring?

The answer to this question came as a distinct surprise. Just exactly half of the definite answers were *negative.* Another half of the definite answers were *affirmative.* But—there were a great many who qualified their answers, stating that there was not enough data available to base an opinion on a question of this nature; and some who distinctly leaned to the affirmative side, but because of a lack of data, would not definitely commit themselves.

It seems as though some of those working along the lines of sex control should look into the subject from a Mendelian viewpoint.

The subject of *drink* was rejected, as was the question about sunlight having an effect, the moon having an effect, or the particular point of origin of either the spermatozoon or the ovum (right or left side).

## Not Yet!

### In Humans, Say Scientists But

## SOON!

**THE consensus of opinion of the scientists who answered the questionnaire on the subject of the control of sex is *"while sex cannot as yet be controlled in the human individual, it can be, and is controllable in the bird, animal, and insect worlds, and it is quite possible that in the not too distant future, sex in human beings will also be controlled."***

**In response to the other questions which were asked, we find that the scientists are divided three to two in favor of *syngamous* versus *progamous* theory of sex determination. The former theory holds that the determination of sex takes place at the same time that the union between the spermatozoon and the unfertilized egg occurs. The progamous theory holds that the sex of the future individual is determined by either the spermatozoon or the ovum before fertilization.**

**All of the theories of sex control were rejected except one, and this one has heretofore had but very little attention paid to it. The negative and affirmative votes were divided equally, but a vast number swayed to the affirmative side. This applied to a Mendelian basis of sex control, in which it is assumed that both father and mother have many blood relations of the same sex (either all brothers or all sisters in both families).**

### *A Few Letters*

SO that the reader may get a better insight into this subject from the viewpoint of some of the experts interested in it, we are appending a few letters from those who were so kind as to answer the questionnaire, or so thoughtful as to add some personal notes or opinions of their own. We will appreciate and be glad to further disseminate knowledge to our readers on this interesting topic. We trust that this series has been the means of spreading much authoritative information along these lines which was never generally known before.

### *A Letter by Dr. Reed O. Brigham, Ph.D., M.D., Toledo, Ohio*

THE April, 1922 Physiculture Magazine published an article by Dr. David H. Reeder on the predetermination of sex, the theory of which the writer questioned and since that time he has been observing and studying and would like to submit the following facts and theories. Dr. Reeder believes that the time of conception in regard to the menstrual period determines the sex. He also mentions the German theory, and more recently Professor Fetscher of Berlin has given a similar theory claiming also that older parents give birth to more boys with statistics on 1,796 families. The writer has made a study of 3,944 births in his father's and own practice and could not in any way substantiate these above theories or see any relation whatever.

The question of sex has been an insistent one; it is today particularly so because of the rapidly expanding activities of women in all the affairs of life. (*Continued on page* 994)

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# *This discussion of sex control takes into consideration past ideas on the same subject*

**DR. BENEDICT bases his statements in this article on observed actual tests in which he claims the birth ratio has been changed from a normal fifty-fifty sex distribution of male and female births to a startling predominance of male births, which in some cases ran as high as nine to one. Unfortunately, he has been unable so far to demonstrate the reverse of this condition.**

NATIONS' MAN POWER
NATIONS' WAR POWER
NATIONS' LOSSES IN WAR TO THE FINISH
JUST AS MANY WOMEN DIE BECAUSE OF STRESS AND SUFFERING

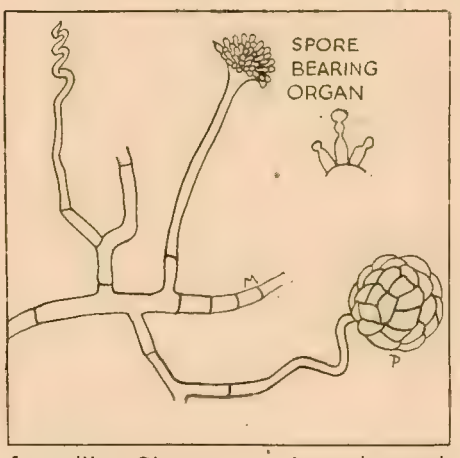
*It has frequently been said that after every war, the number of male births is greatly increased which is supposed to be nature's way of maintaining the balance. As a matter of fact, a war fought to the finish, means that about one-sixth of the forces are killed, and under modern conditions, no nation can put into its army more than 10% of its population.*

productive cells, more or less different from each other, at least in size. Each of these cells must give up part of its own structure, namely half of its chromosomes, before this union takes place. But the new cell, formed from parts of two distinct cells, has the power to grow into all the cells, however varied in type, necessary to duplicate the parent individuals. Here we have the development of sex. That is to say, the reproductive cells of different individuals of the same species are of two distinct types and two reproductive cells of the same kind cannot unite and form a new being. More than this, the parts of the plant or animal which produce and discharge the reproductive cells show marked differences, not only in form but to suit the exact mechanic roles in which they are engaged. The highest plants as a rule, unite both sexes in the same individual, even in the same assemblage of reproductive parts, which we call the flower. Even when individual plants are of one sex, as in the case of the poplars and willows, there is usually not much difference in the individuals, except so far as the distinctly sexual parts are concerned.

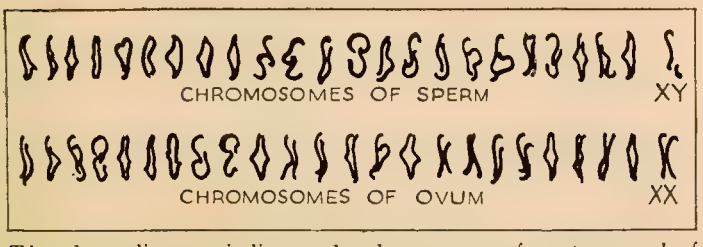
In the animal kingdom, the union of the two sexes in the same individual occurs only in organisms of relatively low rank, as some worms. Vestiges of each sex, however, remain in the highest types though very rarely visible except microscopically and a true, complete merging of the two sexes in the same individual probably never occurs. But, in the higher animals, not only is sex distinct in the reproductive cells and the organs directly concerned in their formation and discharge, but sex permeates almost the entire organism. Secondary sexual characteristics are conspicuous in epithelial structures, the distribution of hair, feathers and horns. The contour and size of the body differ according to sex. In mammals, with some few exceptions, the milk-secreting glands are mere vestiges in the male. The larynx, and hence the pitch of the voice, show sexual differences, even the psychology of the individual usually corresponds to sex and this difference is by no means limited to human beings.

Sexual reproduction requires only one cell from each parent. Indeed, there is almost positive proof that the cell formed from the union of two single cells of different sex may divide so as to form two, three or occasionally more offspring, although not all twins and triplets are thus formed. In accordance with the general principle that Nature is exceedingly lavish, almost wasteful, in insuring the accomplishment of her ends, many thousand reproductive cells are formed in each individual female while the male reproductive cells may number millions in a single discharge and billions for the life of the individual. Pollen, the male reproductive cells of plants, is sometimes so abundant as to form clouds. In some cases, the female reproductive cells of plants are fertilized and mature with comparatively little waste, again from an abundance of flowers, only a few produce fruit. For mammals, the net result in offspring for the most prolific scarcely reaches a thousand for the male and a hundred for the female. Obviously, for the larger

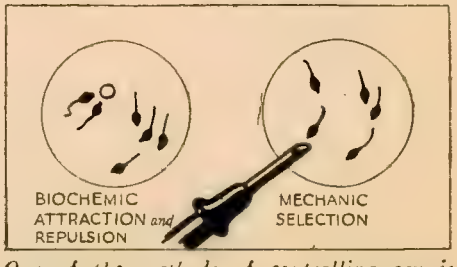
(Continued on page 987)




*Aspergillus Glaucus, a sexless microscopic fungus. M. (mycelia), the branching part of the plant. P. peritchecium. The spore-bearing organ is shown with part of it enlarged, the spores just about to break loose.*




*The above diagram indicates the chromosomes of a sperm and of an ovum, showing the XX and the XY chromosomes, about which much has already been written. This illustration is credited to Theophilus S. Painter, University of Texas.*




*One of the methods of controlling sex is illustrated above. It shows the biochemic attraction and repulsion by chemical or other means, and the mechanical selection.*

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# And Sex Controlled

## Sex is Being Controlled in Animals, Why Not in Man?

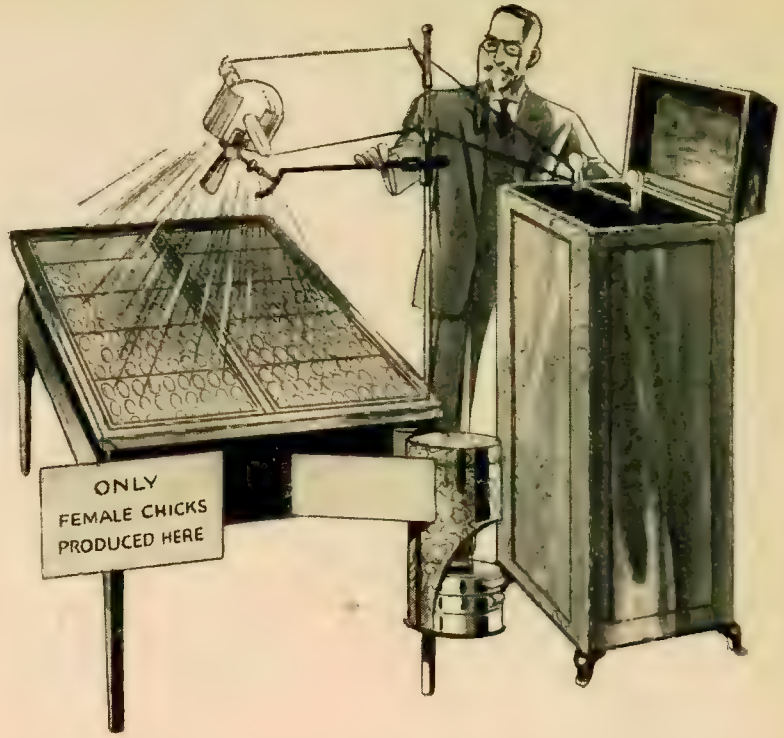
SCIENCE AND INVENTION will present beginning next month, a series of important articles on

## EVOLUTION

SCIENCE AND INVENTION having just concluded its series of articles on *Sex Control* has secured three most important articles from the pens of America's greatest scientists on the subject of evolution.

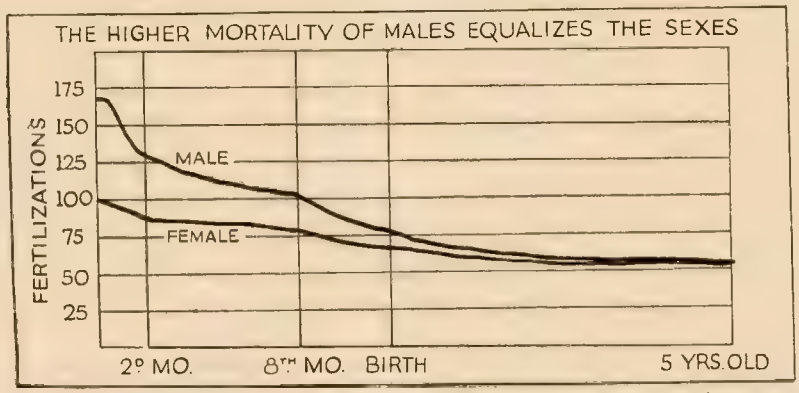
A great deal of nonsense has been written about evolution in the past, and SCIENCE AND INVENTION feels that it is its duty to present the most accurate scientific data that can be procured on this most important as well as controversial subject.

The first article on evolution has been written by Prof. Samuel C. Schmucker, one of the leading authorities on the subject. The articles will run for the next three months and Prof. Schmucker's illustrated article will appear in the March issue.



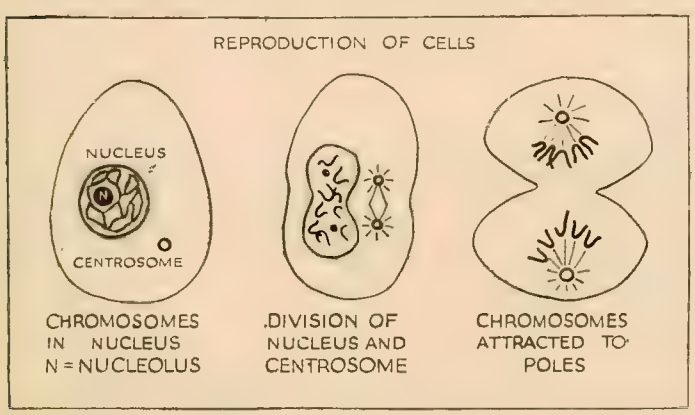

*Exposing hens eggs to X-ray while they are in an incubator, increases the proportion of female chicks and ultimately eliminates the male chicks altogether, so that only female chicks are born. Of course, the extent of the exposure controls this.*

that are alive today have had a continuous existence since the beginning of life in the world. It is true that one generation has followed another but the parent generation has never died. There has merely been the transfer of part of it to the next generation and while tissues have shrunk and been wasted and restored by nourishment taken in, there has never been death in any truer sense than applies to the chemic and nutritional changes which occur in the organism of any higher animal. There is a close approach to physical, material immortality in the reproduction of sexless one-celled organisms.




*This graph shows the percentages of male births to female births. Of course, such percentages are approximate, as statistics on this subject are not accurate. Nevertheless, one will find here that a greater number of male fertilizations take place in a ratio considerably higher than one would expect by the ordinary laws of chance.*

All animals and plants beyond the simplest type also have the cell as their unit but consist of aggregations of enormous numbers of individual cells, many of which have been altered from their original type to serve special purposes. In man, and indeed in mammals and other vertebrates, each white blood cell is essentially an independent one-celled organism, though not capable of free existence. Of such, the average human being has about forty billion. The red blood cells should normally have lost their nuclei before entering the blood, being reproduced in tributary glands. They are also heavily charged with iron in a special compound which serves to carry oxygen from the lungs to the other cells of the body. Of these cells we have about thirty trillion. As about half of the blood, by volume, consists of cells and as all the blood makes up about one-thirteenth of the body, we may estimate that the whole number of cells approaches a quadrillion.




*This illustration shows the reproduction of cells. It will be observed that the centrosome and nucleus divides. The chromosomes rearrange themselves and as the centrosomes pass to opposite parts of the nucleus, the chromosomes are attracted to the poles. Division of the nucleus then takes place.*

As soon as an organism passes the one-celled stage and consists of large numbers of cells, variously modified and often deprived of their active centers, the nuclei, it obviously cannot reproduce by the division of its cells indiscriminately even if it could be imagined that all of the cells could undergo the reproductive urge at the same moment of time. Hence, special cells retain the reproductive function and, being more or less independent of the other cells, produce new organisms without requiring that the parent organism should be merged in those of its descendents. But, the parent organism, being able to survive as a distinct unit after it has reproduced new organisms sacrifices the physical immortality of the simplest, one-celled organism. The simplest type of reproductive cell is the spore but there is yet no distinction of sex.

### *Reproduction*

Still higher animals and plants require for reproduction the union of two special re- (*Continued on next page*)

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*Dr. A. L. Benedict, A.M., M.D., the author of the present article, on the subject "Can We Control Sex?" who has devoted much time and research to the problem of studying hereditary characteristics.*

*Many obstacles can be overcome—*

**It is by No Means Illogical to Suppose That a Method When Added to the Law of Chance Could Not Produce An Efficiency of 80 to 90 Per Cent.**

# Can We Control Sex?

By DR. A. L. BENEDICT, A.M., M.D., F.A.C.P.

THE majority of intelligent and educated persons have long regarded the voluntary control of sex as impossible. François Mauriceau, a celebrated French obstetrician of the late seventeenth and early eighteenth century, spoke very scornfully of an astrologer who had miscalculated the date of birth of his child and gave him credit only for a lucky guess in foretelling its sex.

*It has been found that semen taken from a frog and immediately used to fertilize ova produces approximately equal numbers of males and females. As the attempt at fertilization is delayed, the proportion of males becomes greater until after four days, only males result.*

However, when we consider how many apparent impossibilities of the comparatively recent past are every-day facts of the present, both in mechanic and chemic inventions and medical art, the temptation is strong to agree with the nineteenth century sceptics who declared that man could no more control sex than he could fly.

From the experimental standpoint, dealing with such lower forms of animal life as the amphibians (frogs, toads, etc.) and birds, the problem of controlling sex actually has been solved. In a sense, the problem for these creatures has been too well solved for, apparently, it has been possible to convert one sex into the other. However, other experiments and observations on animals more closely resembling man, have apparently been partially successful in controlling sex of as definite and unchangeable nature as we believe it to be for human beings.

### *Cell Never Dies*

THE simplest organisms, animal or vegetable, consist of a single cell. The vital portion of the cell is its distinct central portion, termed the nucleus. Both the outer portion of the cell and the nucleus consist of protoplasm of no particular structure, held together by fibres. The fibres of the nucleus stain deeply with certain dyes and hence are called chromosomes (meaning color-bodies). The chromosomes are believed to be characteristic in number for each kind of plant or animal whether the latter consists of one cell or many. The one-celled organisms reach an active stage in which the chromosomes become especially prominent, and divide into two bundles at opposite poles of the nucleus. The protoplasm of the nucleus indents at the equator between these poles, the separation of the cell becomes more and more marked until it divides completely, each polar bundle forming the nucleus of a new cell which soon gains size by imbibing nourishment so as to equal the original cell. While mere drying, exposure to heat or cold of undue degree or some other accident may kill millions of one-celled organisms, those

*The laws of chance would seem to show that just as many boys as girls are born. While there may be a series of ten or fifteen heads in succession, on the average, and in the long run, the ratio will approximate a fifty fifty basis after a number of coin flips. Yet—see the next page, middle illustration.*

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H. Winfield Secor, *Managing Editor* Hugo Gernsback, *Editor-in-Chief* Dr. T. O'Conor Sloane, Ph.D., *Associate Editor*

Volume XVI. Whole No. 190. February, 1929. Number 10.

# EDITORIAL

*"Those Who Refuse to Go Beyond Fact Rarely Get as Far as Fact"* - - HUXLEY

## AMATEUR ASTRONOMY

By Hugo Gernsback

IT is, I believe, a most healthy sign, as to scientific interest in this country, when we note the continuous progress made in amateur astronomy.

Even as late as ten years ago, astronomy was generally considered to be something most abstract and highly technical—something in which, perhaps, college professors were interested, but which did not concern the man in the street.

It is truly remarkable what happens when Science and Invention, for instance, publishes an article on how to make a telescope. The flood of letters from those interested in building it at once, is unparalleled in the case of any other constructional article in the magazine. It can only be compared with the fever that seized the country in 1921-1923, when everyone, over-night, seemed to be imbued with the desire to build a radio set.

And while the wonders of radio are great; and while it was a great thrill to receive a station 500 miles distant in your earphones; what thrill is this, when you compare it with viewing the canals of Mars, Jupiter's red spot and its moons, or Saturn's gorgeous rings through your own home-made telescope? For it should be understood, that to-day anyone handy with tools and having a little knowledge of mechanics, can build himself such a telescope in short order, at an expense that is often not much greater than $50.00 for a modest telescope. And, of course, it is not absolutely necessary to have an observatory, because the amateur astronomer finds it most convenient to explore the heavens from his own back yard, or if he has none, then, from the roof of his apartment house.

And only those who have viewed the heavens through a telescope know what a tremendous stir it gives to the imagination; how it sharpens your senses, and how it uplifts you, as practically nothing else can ever do.

As a hobby, I much doubt that there is anything that comes anywhere near competing with amateur astronomy. The amateur astronomer is not content to build himself just one mediocre telescope. He is very much like the radio enthusiast, in that no sooner has he finished one telescope, than he already visualizes a larger and better one. Many men who are readers of Science and Invention have built as many as six and in some few instances, as many as ten telescopes, from the smallest to respectable-sized ones. Once you get the fever, it is difficult to stop.

And let no one think that amateur astronomy means only the building of telescopes and gazing at the stars. While the building of the telescope is, of course, an absolute necessity; still, it presents only a single phase of the work in this art. After you have built your first telescope and have achieved good results, of course, you will scan the heavens and get a good look at the various planets and the many stars, nebulæ, and last, but not least, our closest neighbor in space, the moon.

Yet this is only the beginning. Sooner or later, the true disciple of the art will become imbued with the desire to build his own modest observatory, which may be nothing but a simple shed; or if he has the means, it may mean a regular observatory with a revolving top, which latter, of course, runs into a great deal of money. But with a little ingenuity, the average garage can be converted into an excellent observatory, at an expense of less than $200.00.

After this, the amateur astronomer becomes more ambitious, and his next step will probably be to fit his telescope with a camera in order to photograph what he sees. Many amateur astronomers thus obtain most excellent photographs, many of which have been widely published. But before he can take such photographs, it is, of course, necessary to provide the telescope with a driving clock in order that the telescope can follow the various celestial bodies without the observer changing the orientation of the telescope every few seconds.

Such driving clocks can either be bought, or more rarely, are made by the astronomers. Or, if the amateur does not wish to go through all this trouble, he can do what most professionals do, and that is, make colored sketches on paper of the various planets and their markings. There is still another way to do this even better. Some of the scientific houses sell small white globes upon which the markings of the moon, Mars and of the other planets can be drawn by hand with colored pencils. Such models are of great importance, particularly when some of the planets, such as Mars, are in opposition to the earth and when it becomes highly important that as many observers as possible copy the actual markings. It is easier for the human eye to follow these markings, because fine lines such as the canals on Mars have never been successfully photographed, due to the earth's air currents, which tend to blur the photographic picture. The eye corrects these variations, and the amateur astronomer is, therefore, in a position to take down the markings in their relative positions on the white model globe.

*Mr. Hugo Gernsback speaks every Tuesday at 9.30 P.M. from Stations WRNY (297 meters) and W2XAL (30.91 meters) on various scientific subjects.*



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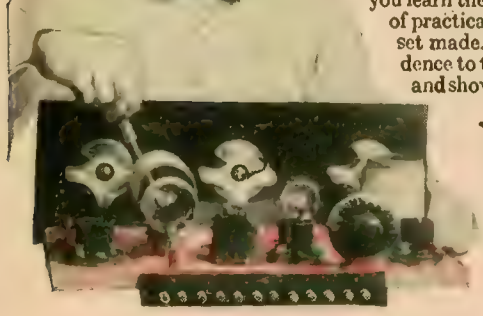

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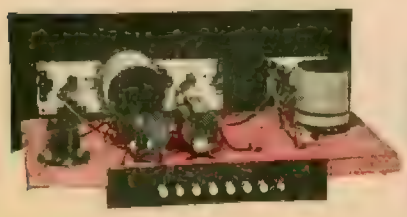

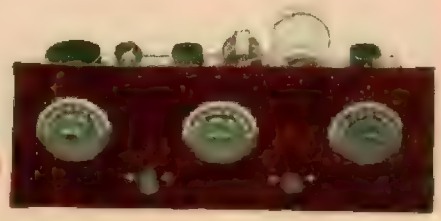

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# INDEX TO ADVERTISERS


| | Page |
|---|---|
| **A** | |
| A. H. S. Electrical Service & Engineering Bureau | 998 |
| Aero Products, Inc. | 1000 |
| Allied Radio Corporation | 962 |
| American School, The | 897-982 |
| American School of Aviation | 982 |
| American School of Music | 1003 |
| American School of Photography | 962 |
| American Technical Society | 976 |
| American Telephone & Telegraph Co. | 993 |
| Andrews, Frank | 995 |
| Anita Institute | 1003 |
| Ansonia, The | 998 |
| Artee Radio Sales & Mfg. Corp. | 973 |
| Audel & Co., Theo. | Inside Back Cover |
| Automatic Rubber Company | 986 |
| Aviation Institute of U. S. A. | 1001 |
| **B** | |
| Barawik Co. | 978 |
| Blackstone, Richard | 997 |
| Bliss Electrical School | 960 |
| Boice, W. & J. | 979 |
| Buescher Band Instrument Co. | 972 |
| Bureau of Inventive Science | 982 |
| Burns School of Wrestling | 970 |
| **C** | |
| Chemical Institute of N. Y., Inc. | 975 |
| Coleman Electrical School | 979 |
| Coleman, Watson E. | 982 |
| Collins, E. | 967 |
| Conn, Ltd., C. G. | 1001 |
| Cox, S. J. | 964 |
| Coyne Electrical School | 899 |
| Currier Mfg. Co. | 979 |
| Cyko Mailing Service | 982 |
| **D** | |
| Deagan, Inc., J. C. | 970 |
| Delta Specialty Co. | 965 |
| Detroit School of Lettering | 978 |
| Dobe, Fred'k W. | 997 |
| Doran Oil Burner Co. | 97[illegible] |
| Douglas, Lyle | 9[illegible] |
| Dryer, Prof. J. A. | 995 |
| Dubilier Condenser Corp. | 969 |
| Dynamic Mfg. Co. | 976 |
| **E** | |
| Evans & Co., Victor J. | 983 |
| **F** | |
| Fawcett Publications, Inc. | 971-1008 |
| Federal School of Illustrating | 991 |
| First Hawaiian Conservatory of Music | 982-988 |
| Fisher Mfg. Co., Adam | 980 |
| France, B. H. | 999 |
| Franklin Institute | 997-1005 |
| Franklin Publishing Co. | 1001 |
| Free Thought Press Ass'n, The | 963 |
| **G** | |
| Gaston Mfg. Co. | 966 |
| Gerstner & Sons, H. | 979 |
| Givens Chemical Co. | 974 |
| **H** | |
| Hagan, D. A. | 992 |
| Harre, F. A. | 1000 |
| Hernic, John M. | 979 |
| High School Home Study Bureau | 976 |
| Hobart Brothers Co. | 962 |
| Honigman, A. | 970 |
| Hotel McAlpin | 964 |
| Hotel Manger | 986 |
| Hotel Montclair | 992 |
| **I** | |
| Ideal Aeroplane & Supply Company, Inc. | 988 |
| Illinois College of Photography | 976 |
| Independent Electric Works | 978 |
| Inkograph Co. | Back Cover |
| International Correspondence Schools | 970-974-978-988 |
| **J** | |
| Jenkins Corporation | 974-1003 |
| Jones Matrola Sales Co. | 1000 |
| Jowett Institute of Physical Culture, The | 986 |
| **K** | |
| Keeley Institute, The | 988 |
| Kelsey Co., The | 976 |
| **L** | |
| Lancaster & Allwine | 982 |
| Laboratory Materials Co. | 982 |
| Landon School, The | 986 |
| LaSalle Extension University | 993 |
| Lederer School of Drawing | 1003 |
| LePage's Craft League | 987 |
| Liederman, Earle | 1003 |
| Lincoln Airplane School | 1000 |
| Logan Toy Works | 972 |
| **Mc** | |
| McCathran, Irving L. | 979 |
| McSweeney Electrical School | 960-974 |
| McGraw-Hill Book Co. | 989 |
| **M** | |
| Major Mfg. Co. | 964 |
| Mann & Benton | 970 |
| Marvel Mfg. Co. | 978 |
| Mason, Fenwick & Lawrence | 982 |
| Metal Arts Co. | 978 |
| Metal Cast Products Co. | 978 |
| Meyer Both Company | 976 |
| Midwest Radio Corporation | Inside Front Cover |
| Miller, Carl | 982 |
| Miller, Monroe E. | 982 |
| Miniature Ship Models, Inc. | 1001 |
| Modern Antenna Co. | 995 |
| Monica, Harry | 995 |
| Mount Carmel Mfg. Co., The | 966 |
| Munn & Co. | 980 |
| **N** | |
| National Radio Institute | 901 |
| National Salesmen's Training Assn. | 904 |
| National School of Visual Education, The | 964 |
| New Method Mfg. Co. | 982 |
| New York Academy of Music | 960 |
| N. Y. Electrical School | 900 |
| N. Y. Institute of Photography | 988 |
| North American Institute | 985 |
| Northwestern School of Taxidermy | 966 |
| Norton Institute | 966 |
| **O** | |
| O'Brien, Clarence A. | 981 |
| Open Road for Boys Magazine, The | 979 |
| **P** | |
| Paris-American Pharmacal Co. | 994 |
| Parks Woodworking Machine Co., The | 1003 |
| Pathfinder | 966 |
| Patterson School | 986 |
| Perfect Penmanship Institute | 986 |
| Plymouth Rock Squab Co. | 974 |
| Polachek, Z. H. | 980 |
| Polk & Co., R. L. | 974 |
| Popular Book Corp. | 984 |
| Popular Chemistry Co. | 997 |
| Porter Chemical Co. | 974 |
| Press Guild, Inc. | 1005 |
| Publishers' Classified Service | 998 |
| **R** | |
| Radio Assn. of America | 968-979 |
| Radio Institute of America | 959 |
| Radio Specialty Co. | 994 |
| Ralston University Press | 903 |
| Randolph & Co. | 980 |
| Rawner Radio & Television Co. | 979 |
| Roat and Lohman | 997 |
| Renuzit System, The | 1000 |
| Ronald Press, The | 962 |
| Ross-Gould, Inc. | 970 |
| **S** | |
| School of Engineering of Milwaukee | 968 |
| Setbuilders Supply Co. | 976 |
| Snyder, C. G. | 968 |
| South American Service Bureau | 995 |
| Speedo Mfg. Co. | 968 |
| Standard Business Training Institute | 979 |
| Stone, M. L. | 997 |
| Strongfort Institute | 961 |
| Studebaker Corporation of America, The | 977 |
| **T** | |
| Tamblyn, F. W. | 976 |
| Tarbell Systems, Inc. | 902 |
| Townsend Laboratories | 970 |
| Trilety, M. | 978 |
| **U** | |
| U. S. Model Aircraft Corp. | 986 |
| **V** | |
| Van Nostrand Co., Inc., D. | 966 |
| **W** | |
| Waco Tool Works, Inc. | 968 |
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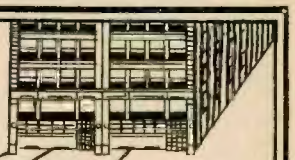

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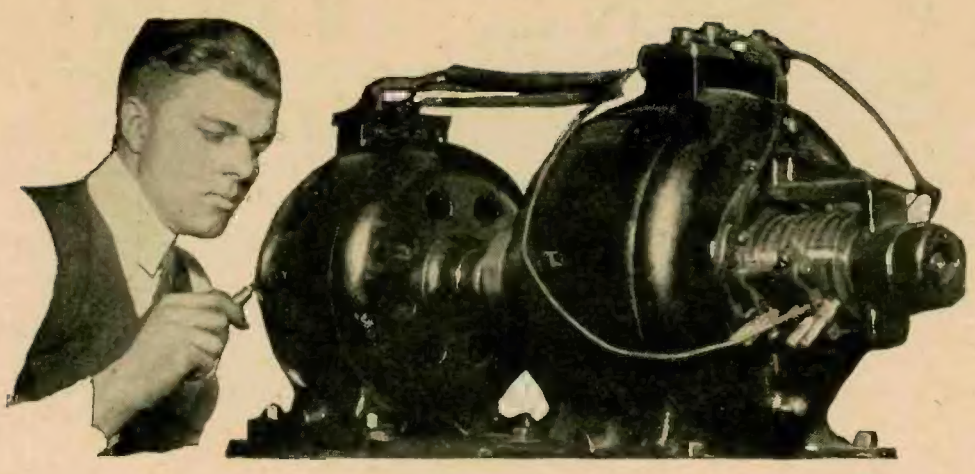

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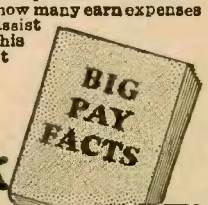


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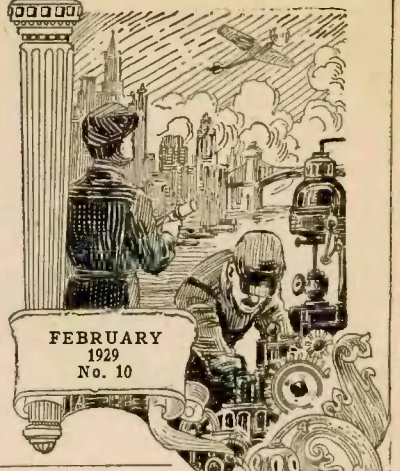

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## CONTENTS OF THIS ISSUE

**GENERAL SCIENCE**

Editorial ..... 905
*By Hugo Gernsback*
Can We Control Sex? ..... 906
*By Dr. A. L. Benedict, A.M., M.D.*
A New Safety Boat ..... 910
*By Hugo Gernsback*
Shattering the Atom ..... 913
Giant Bridge Joins Two States ..... 914
*By H. Winfield Secor*
Mechanical "Lungs" for Men Entrapped in Submarines ..... 916
*By C. H. Dacy*
Jupiter's Moon in the Making ..... 918
*By Donald P. Beard*
The Living Head ..... 922
*By Joseph H. Kraus*
Aviation Advances ..... 924
Scientific Progress ..... 926
Labor-Savers Shown at New York Electric Show ..... 928
Science Invades Toyland ..... 930
All About Electric Fish ..... 932
*By Dr. Ernest Bade, Ph.D.*
Scientific Problems and Puzzles ..... 934
*By Ernest K. Chapin, M.A.*
Magic—A Monthly Feature ..... 935
*By Dunninger*
Readers Forum ..... 948
Scientific Humor ..... 956
Latest Patents ..... 957
The Oracle ..... 958
Patent Advice ..... 980

**AVIATION**

Aviation Advances ..... 924

**CHEMISTRY AND ELECTRICS**

Shattering the Atom ..... 913
Experimental Chemistry and Electrics ..... 940
*Edited by Dr. T. O'Conor Sloane*

**HOME MOVIES**

Everyday Chemistry ..... 941
*By Raymond B. Wailes*
Building an Electrical Mystery Pendulum ..... 944
*By C. A. Oldroyd*
Home Movies—A Monthly Department—"Artificial Lighting" ..... 938
*Conducted by Don Bennett*

**TELEVISION**

Television Light Modulator ..... 950
*By Paul L. Clark*
Boys Learn Television in Classroom ..... 951

**RADIO**

The Radio Altimeter ..... 952
New Radio Devices ..... 954
Radio Oracle ..... 955
Dynamic Transmitter ..... 957

**AUTOMOTIVE**

Spike Stops Speeding Autos ..... 926
Motor Hints ..... 933
*Conducted by George A. Luers*

**ASTRONOMY**

Jupiter's Moon in the Making ..... 918
*By Donald P. Beard*
World's Largest Telescope ..... 920
*By Dr. Donald H. Menzel, Ph.D.*
Building a Reflecting Telescope ..... 942
*By Ernest W. Blandin*
How to Build a Refracting Telescope ..... 943
*By Dr. Donald H. Menzel, Ph.D.*

**HOW TO MAKE IT**

Model Department ..... 936
An Electric Tube Furnace ..... 940
*By Raymond B. Wailes*
How to Make It Department ..... 944
Wood Turning ..... 945
*By H. L. Weatherby*
Wrinkles, Recipes and Formulas ..... 946-947
*Edited by S. Gernsback*

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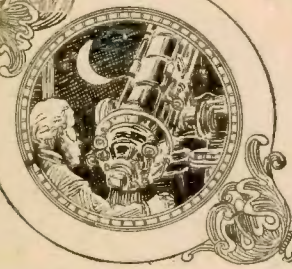

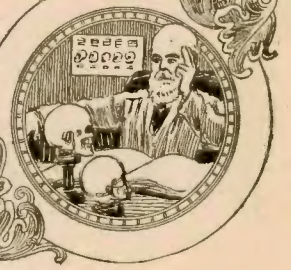

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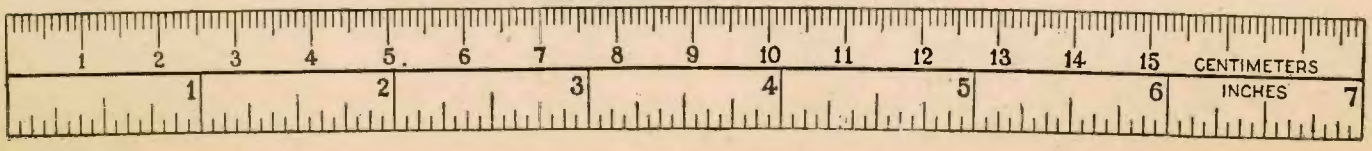




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